

Testing an Actor-Network Theory Model of Innovation Adoption with Econometric Methods.

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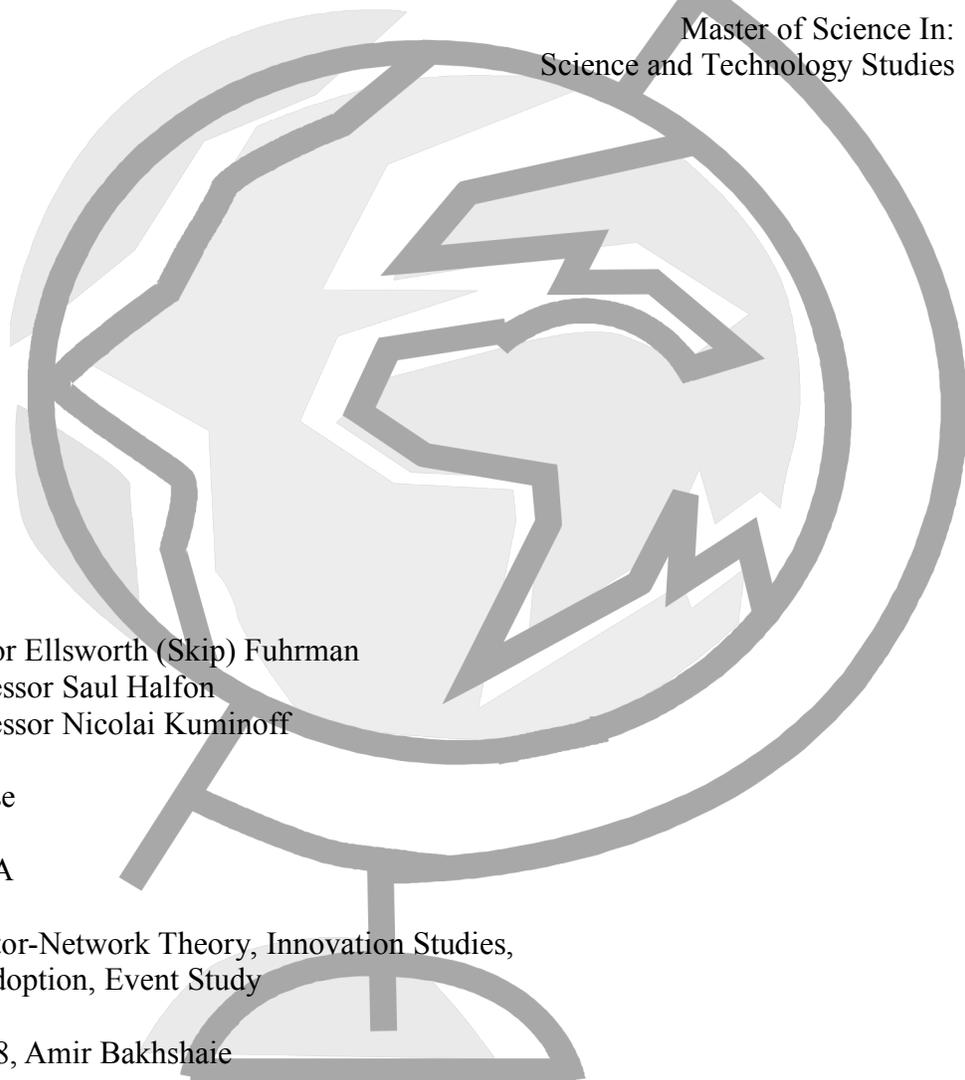
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(ABSTRACT)

In this Thesis I will examine technology adoption by analyzing how different organizations come to interpret a technology as a specific kind of innovation based on a certain set of criteria. The kind of innovation an organization interprets a technology to be affects how quickly the organization will adopt that technology. To analyze how organizations come to interpret technologies as a specific kind of innovation I will construct a model. I will utilize the Actor-Network Theory from Science and Technology Studies as the framework to combined theories regarding technology adoption from other disciplines. This new model of technology adoption will be able to address the individual weakness of each theory that I use, and at the same time build on the strengths of the Actor-Network Theory. I will conclude my thesis by testing my new model using an event study from econometrics. Using the surrogate measure of the stock market to represent consumers, the event study will allow me to gauge if the kind of innovation a technology is interpreted as affects the rate of its adoption.





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CHAPTER 1

Introduction

Purpose:

In this thesis I am going to examine technology adoption. Specifically I will construct a model that can be used to understand what factors affect how quickly a technological innovation is adopted. For the purpose of this thesis I will use this new model to either reject or accept the null hypothesis that societies adopt technological innovations mainly based on their technical specifications. To test the new model, I will use the stock market as a surrogate measure for society, and use an event study from econometrics to test how society judges which technological innovation will be successfully adopted in the future.

I will not be examining how a society as a whole adopts technology, but instead the model I construct will break society into its individual groups. My model will examine the technology in the context of each of these individual groups, and my model will demonstrate that the kind of innovation each group interprets a technology to be effects how quickly they adopt it. My model will not have a set number of individual groups that can be examined for a given technology, but the kinds of innovation will be broken down into four groups. My model will have enough flexibility to address the specific needs of the different individual groups that are a part of a given society.

My model will have this flexibility because it will be based on Bruno Latour's Actor-Network Theory (ANT). It should be stated that ANT provides more of a





framework for understanding how society makes sense of technology than a set theory with a complete system of ideas. By utilizing the ANT framework I will be able to incorporate other theories on innovation adoption to create a more robust model. For this thesis I will start out by incorporating two theories into the core of the model that I will use to exam how different individual groups come to interpret and adopt innovative technologies. I will utilize a third theory to explain more of the intricate workings of technology adoption in the specific case that I will be examining in this thesis. In the future I want to be able to incorporate other relevant theories into this model, and I am confident that the groundwork I will lay down in this thesis will allow me to do that.

The two theories I will incorporate into the core of my model come from Neoinstitutionalism, and they are: Allan N. Afuah and Nik Bahram's Hypercube model and Fariborz Damanpour and Deepa Aravind's Product versus Process innovation model. These models were pivotal in demonstrating the institutional and organizational effects on innovation adoption for Neoinstitutionalism. The version of ANT I will utilize is found in Bruno Latour's *Science in Action*.¹ I will use this version of the Actor-Network Theory because this is the first time that the theory appears in its complete form while still remaining malleable. The ANT framework will give my model more malleability to account for a wider range of social factors, and ANT will give my model a coherent framework and language for understanding technological adoption between the different models I am incorporating.

I will start off my model by deconstructing each of the two Neoinstitutionalism models. During this process, I will create a list of terms that I will later incorporate into

¹ Latour, Bruno (1987). *Science In Action: How to Follow Scientists and Engineers Through Society*, Harvard University Press, Cambridge Mass., USA.





my new model. I will summarize important concepts regarding the two Neoinstitutionalism models, and provide examples of how they are utilized. By deconstructing these models in this manner I hope to demonstrate the weakness each model faces. To construct my model I will use the six core principles that guide ANT. I will systematically review these six principles and some other key concepts of Actor-Network Theory to methodically construct my model.

After I finish constructing my model I will test it by applying it to the new generation of video consoles. There are three consoles in this new generation: Nintendo's Wii, Microsoft's Xbox 360 (360), and Sony's Playstation 3 (PS3), but I will be primarily be focusing on the PS3 in my utilization of my model. My model will distinguish what kind of innovation the PS3 console constitutes for the varying organizations involved, and then go on to predict if the PS3 will have any difficulty in being adopted by society. For the purposes of this thesis, society will mean American consumers.

I will use econometrics to test my model. I am going to use a surrogate measure of the stock market as a replacement for the American consumer. I understand that this is not a perfect match. However, I need a way of gauging society's reactions to information about a technology as it becomes available to test my model, and given my limited resources, the stock market is best suited for this task.

An important metric for valuing stocks is perceived future growth, and as such, stock prices will fluctuate if the market feels that consumers will or will not buy a product in the future. It is this behavior that I will use to test my model. I will look at all the major press releases for each console up to the release date of the product. Based on





this information my model will determine which console has the highest likelihood of being adopted by consumers. My surrogate measure, the stock market should reflect my model's prediction through the fluctuation of the stock price--increasing the stock price of the companies that will have a successful product and lowering the stock price of those it feels will not.

Each of the three video game console makers are large companies with many products. I will need to conduct an econometric event study in order to isolate the effects of selected press releases on each stock.² The event study is a standard tool in econometrics for analyzing how new information is capitalized into stock prices. An event study comprises of choosing a particular event within a window of time and examining if that event has an effect on a company's stock price. Such things as the general movement of the stock market and other information can in large part be accounted for in an event study. In Appendix III, I have created a hypothetical example showing how I will use the movements of a stock to test my new model.

In my case the events will be the press releases regarding each console. I have collected all the press releases for each console starting from the first one that primarily focuses on some major aspect of the console and ending with the one that announces the launch of the console.³ There are 14 relevant press releases for Sony's PS3. The dates for these press releases range from May 2004 to November 2006. There are 10 relevant press releases for Microsoft's 360 with dates ranging from March 2005 to November

² What I used as my guide for conducting a traditional event study was Princeton University library's Data and Statistical Services. Their website is: http://dss.princeton.edu/online_help/analysis/analysis.htm (accessed 5/5/2007)

³ I acquired these press releases from each company's main website.





2005. There are 14 relevant press releases for Nintendo's Wii with dates ranging from March 2005 to November 2006. I define relevant as any press release where, at the time of its release, its main focus is the console or any major aspect of the console.

In the end, by creating my model and testing it with the event study I will offer evidence to reject or accept my null hypothesis. My model will suggest that there are many different factors involved in a technological adoption by a society, and that technological specifications is just one of these. My surrogate measure, the stock market, will test my model by suggesting that the market expects consumers to consider these other factors and not just look at technological specifications.

Background:

Technological innovation is heralded as the engine of economic growth and business success. Society places so much faith in this assumption that whole sub-fields of economics and corporate strategies are built on it. (e.g. Neo-Schumpeterian Economics⁴) A practical example of this now ingrained belief derives from my personal experience at Sun Microsystems during the summer of 2007. All electronic communications and meetings regarding company growth were built on the premise that technological innovation will create the growth needed for success. Sun prides itself on spending 100s of millions dollars a year on being innovative. Sun is not alone in this behavior, and most other companies and governments place a similar premium on innovation—the tantalizing yet elusive lodestar that seems to guide and motivate much of

⁴ Schumpeter defined the term economic innovation in 1934, and has since been seen as the father of innovation theory.





modern development.

Yet the phrase innovation itself is ambiguous to a certain extent, and its definition varies depending on who is defining it. For instance, the definition popularized by Luecke and Katz's in business schools generally places innovation as “the introduction of a new thing or method. . . . Innovation is the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes, or services.”⁵ This definition might serve business professionals well, but economists tend to have broader perspectives on innovation and among them Joseph Schumpeter stands out as having developed a comprehensive view of the innovation phenomenon. Schumpeter’s five principles of innovation are:

1. The introduction of a new good—that is one with which consumers are not yet familiar—or of a new quality of a good.
2. The introduction of a new method of production, which need not be founded upon a new scientific discovery, and can also exist in a new way of handling a commodity commercially.
3. The opening of a new market, that is a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before.
4. The conquest of a new source of supply of raw materials or half-manufactured goods, again irrespective of whether this source already exists or whether it has first to be created.
5. The carrying out of the new organization of any industry, as in the creation of a monopoly position (for example through trustification) or the breaking up of a monopoly position.⁶

While the business school definition is focused on organizations as the innovating unit,

⁵ Luecke, Richard; Ralph Katz (2003). *Managing Creativity and Innovation*. Boston, MA: Harvard Business School Press.

⁶ Schumpeter, Joseph (1934). *The Theory of Economic Development*. Cambridge, MA: Harvard University Press.





the economists' definition allows for the economy as a whole to be an agent of innovation.

The OECD has yet another viewpoint, defining innovation as:

Technological product and process (TPP) innovations comprise implemented technologically new products and processes and significant technological improvements in products and processes. A TPP innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation). TPP innovations involve a series of scientific, technological, organisational, financial and commercial activities. The TPP innovating firm is one that has implemented technologically new or significantly technologically improved products or processes during the period under review.⁷

The OECD definition is narrower in focus in comparison to the others. The OECD most likely defined innovation in a much narrower fashion to make it easier to measure innovation in countries.

The above three definitions are just examples of the various ways innovation is defined. It is not my purpose to parse these definitions and suggest how they are different. Instead, I wish to point out the ambiguity of the term innovation, but at the same time note a common theme. The common theme of these definitions is that innovation intends to make someone better off, and that the succession of many innovations grows the whole economy.⁸

Unfortunately this common theme does not define innovation in any clear way, but creates more ambiguity. It is unclear who the someone is that innovation is trying to

⁷ OECD The Measurement of Scientific and Technological Activities. Proposed Guidelines for Collecting and Interpreting Technological Innovation Data. Oslo Manual. 2nd edition, DSTI, OECD / European Commission Eurostat, Paris 31 Dec 1995.

⁸ This common theme can also be found on the "Innovation" page on Wikipedia.org. The site is: [en.wikipedia.org, "Innovation," http://en.wikipedia.org/wiki/Innovation](http://en.wikipedia.org/wiki/Innovation) (accessed November 17, 2007)





make “better off”, or how “better off” should be measured. Is the beneficiary the government, industry, a consumer, or social activists? In economics and the business community, “better off” is usually measured by improvements in technological specifications, like faster CPU speeds, but is a person who only uses his computer for word processing really better off with a 4 ghz CPU than with a 2 ghz CPU?⁹ Beyond this, it is not clear what kinds of innovations or how many are needed for the economic growth. Are all innovations to be treated as having the same growth effect on the economy?¹⁰ These questions are answered in a variety of ways, using a variety of reasons and justifications all of which simply add to the ambiguity of the term innovation.

In this thesis I cannot hope to address all these ambiguities. Nor do I intend to debunk the assumption society holds about the importance of innovation. Nevertheless, since society does view the concept of innovation in such high regard, I will try to clarify just one area of innovation. My thesis will focus on the adoption of technological innovations. In other words, I will look at how a technology is labeled as making people “better off” for the various groups involved with the it. (e.g. individuals who are using it, making it, selling it, etc..) Then I will look at how this label leads to a technology's adoption by society.

Relevance to Science and Technology Studies:

⁹ Especially given that the difference in loading times for word applications between these two speeds are counted in nano seconds.

¹⁰ One of the big divides in business management regarding innovation theory is between product innovation and process innovation. Product innovation is seen as consumers adopting a new technology, and process innovation as organizations adopting new processes in creating the same technology. It is argued that stockholders are usually in favor of process innovations since they promise a higher return on their investment, and consumers usually favor product innovations since they promise improvements in their standard of living. This leads to the question do product innovations have the same effect on economy growth as process innovations, or would focusing on one over the other have a bigger effect on economy growth?





Science and Technology Studies (STS) has contributed heavily to the area of technology adoption. In particular, STS scholars have tried to rebut the traditional held belief in business-economics, and in the business community that “better off” mainly equates to improved technological specifications.¹¹ This belief can be seen manifested in Lewis Abbot book entitled *Technological Development In Industry: A Business-Economic Survey & Analysis*.¹² Abbot reviews the business-economic literature to discover how the term technological innovation is understood in industry. Abbot discovers several beliefs about what technological innovation consists of for industry, two of which are relevant to this thesis. These two beliefs are: “the development, utilization, and application of new scientific ideas, concepts, and information in production and other processes,” and “enhancement of technical performance capabilities, or increase in the efficiency of tools, equipment, and techniques in performing given tasks.”¹³ It is beliefs such as the ones discovered by Abbot that STS tries to rebut.

For instance, STS authors such as Boris Hessen in his book *The Social and*

¹¹ This statement by no means is meant to generalize the entire field of Economics. Within the field of economics there are many varying definitions of “better off.” Recently the Nobel laureate Amartya Sen defined “better off” within the context of the welfare theory. As my committee member Professor Nicolai Kuminoff pointed out, this theory recognizes people are “better off” from a technological innovation depends on the nature of the innovation, its impact on all other consumption goods and services, and the subsequent price changes

¹² Abbott, L. F. (2003). *Technological Development In Industry: A Business-Economic Survey & Analysis*. Manchester, Industrial Systems Research.

¹³ Ibid.





Economic Roots of Newton's Principia,¹⁴ and Pinch and Collins in their book *The Golem at Large*,¹⁵ argue that it is not technological specifications that decide the outcome of a technology being adopted by society. Instead, these authors view the larger social context a technology is situated in as the crucial factor in determining if a technology will be adopted.

Both Hessen and Pinch and Collins used different approaches to come to this conclusion. STS scholars traditionally draw heavily on the disciplines of history, social studies, and philosophy to construct the argument that technology is socially mediated. Hessen was a historian of science who wrote in the 1930s, and Pinch and Collins used social constructivism theories from the sociology of science during the 1970s¹⁶ and 80s.¹⁷ Where my thesis differs from other author STS scholars is that I will use a different approach from traditional STS. I will be using models from the interdisciplinary study of Neoinstitutionalism along with econometric tools to construct this argument.

This thesis is relevant to Science and Technology Studies (STS) for several reasons. My thesis uses a prevalent and important STS theory, STS scholar Bruno Latour's ANT, and it shows how ANT can be applied to various other disciplines. By doing this, my thesis uses an STS framework to create a common understanding between varying disciplines regarding the matter of innovation. Others in STS have already had success in creating a similar framework for such disciplines as history, social science, and

¹⁴ Boris Hessen, *The Social and Economic Roots of Newton's Principia* in: Nicolai I. Bukharin, *Science at the Crossroads*, London 1931 (Reprint New York 1971), pp. 151-212

¹⁵ Collins, H. M., & Pinch, T. J. (1998). *The Golem at Large: What You Should Know about Technology*. Cambridge, United Kingdom: Cambridge University Press.

¹⁶ Bloor, David (1976) *Knowledge and Social Imagery* London & Boston MA: Routledge & Kegan P

¹⁷ Collins, H.M. (1985). *Changing order: Replication and induction in scientific practice*. London: Sage.





philosophy.¹⁸ This thesis will create a STS framework for Neoinstitutionalism and econometrics. In doing this, I seek to strengthen the toolkit of STS by showing how theories from these fields can contribute to discussions about technology and society.

Even though Neoinstitutionalism is interdisciplinary like STS, it draws heavily from the disciplines of economics and business management. Historically STS has rejected economic theories of innovation adoption. An example of this is can be found in the book *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought* by the STS scholar Langdon Winner.¹⁹ Winner, like other STS scholars, believes that even though economic theories can provide some insight, they do not take important social factors into consideration. In part, Neoinstitutionalism was created to address this issue. Certain Neoinstitutionalist scholars used quantitative methods, like econometrics, and borrowed theories from business management and economics to build models that can account for social factors in technology adoption. One such model was the Hypercube model of innovation created by Allan N. Afuah and Nik Bahram. Their model is created as a means to account for the different social contexts that were not included in previous models of innovation adoption.²⁰ The hypercube model aims to break technological innovation into different categories depending on how organizations interact with the new technology. Still, others within Neoinstitutionalism felt models like the hypercube were still not accounting for all the important social factors.

In particular, the scholars Fariborz Damanpour and Deepa Aravind in their 2006

¹⁸ Bruno Latour in his book *Aramis, or, The love of Technology* combines the disciplines of history, social science, and philosophy within ANT to explain why the Aramis Train System failed to be adopted.

¹⁹ *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought*, M.I.T. Press, 1977.

²⁰ Allan Afuah and Nik Bahram, "The hypercube of innovation" *Research Policy* 24, (1995)





article “Product and Process Innovations: A Review of Organizational and Environmental Determinants,” constructed their own model by combining all existing Neoinstitutionalism research on technology adoption.²¹ Their model shows that the social context in which technological adoption happens is more complex than what current Neoinstitutionalism scholars portray. In addition, Damanpour and Aravind stated that a coherent framework for understanding technological adoption in Neoinstitutionalism still does not exist. My thesis will allow me to combine these different theories of technology adoption into a STS framework.

²¹ Jerald Hage and Marius Meeus, *Innovation, Science, and Institutional Change* (New York: Oxford University Press, 2006)





CHAPTER 2

Literature Review

Science and Technology Studies (STS) has contributed heavily to the area of technology adoption. In particular, STS scholars have tried to rebut the commonly held belief that innovation is always a positive force. This naïve faith in innovation is reflected in the business community that sees innovation as a force that needs to be harnessed for them to be successful.²² Specifically, businesses see innovation as a way to increase market growth, profits, and customer satisfaction. This idea of innovation as a positive force is clearly articulated in a vast amount of business literature.

Business Management Literature:

One current example is J.T. DeGraff and S.E. Quinn's book, *Leading Innovation : How to Jump Start Your Organization's Growth Engine*. The vocabulary employed by the authors creates an image of innovation as a force on to itself. The authors advocate “harnessing” the power of innovation to create a culture where real growth happens on a constant basis. The authors have a seven-step playbook that teaches organizations how to “tap” into innovation that will lead to double-digit growth. Innovation is depicted as a

²² Evidence of this belief is not hard to find. Here is an interview with a Microsoft Executive where he continually states the importance of and progressive nature of innovation. <http://www.microsoft.com/business/executivecircle/content/article.aspx?cid=1990&subcatid=300> (accessed February 2, 2008)





“force” that can only assist organizations if properly managed.²³

DeGraff’s concept of innovation is widely distributed in the business community. His book was published just this last year, and he currently teaches an innovation program at the University of Michigan Ross School of Business. In addition, Fortune 500 companies around the world have stated they apply his methods. Due to scholars like DeGraff, the business community has come to understand innovation as a force that needs to be managed from them to succeed.

This idea of innovation being a force is echoed in C. M. Christensen’s book *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. This best selling book claims even the most successful companies can fail in the face of innovation. Christensen argues that the same management decisions that once led a company to success can in the future lead them to fail. For the author, all companies will be forced to face more innovative competitors at some point in time. What Christensen offers as the solution is careful management and understanding of innovation. The author depicts innovation as an inevitable force that each company must face sooner or later, and if these companies do not properly manage innovation then they will ultimately fail.²⁴

Throughout his book Christensen poses several questions that companies should ask themselves. Questions such as: which customers do we want, which technologies will help us to get and then keep customers, should we attack competitors with new technological products, how can we best defend ourselves against technology, should we

²³ DeGraff, J. T. and S. E. Quinn (2007). Leading innovation : how to jump start your organization's growth engine. New York, McGraw-Hill.

²⁴ Christensen, C. M. (1997). The innovator's dilemma : when new technologies cause great firms to fail. Boston, Mass., Harvard Business School Press.





lead or follow, and if we follow, should we prepare to lead later? For Christensen these questions are critical for understanding how technological innovations are adopted, but in general these questions sum up the depth into which the business communities probes into technological adoption.²⁵

Science and Technology Studies Literature:

STS on the other hand has a tradition of asking questions that places technological adoption in its broader social context. As I mentioned briefly in my introduction, there are many STS theories which attempt to model adoption. I started with the two theories that might prove to be the most applicable to this thesis; one being the Social Construction of Technology (SCOT), and the other the Actor-Network Theory,(ANT).

Social Construction of Technology Literature:

The scholars Wiebe Bijker and Trevor Pinch constructed SCOT to address technological determinism in the 1980s.²⁶ STS scholars view technological determinism as problematic, because it posits that newer technology will ultimately push aside its competitors and society will continually adopt these newer technologies. Technological determinism views technology as a force similar to how the current business management literature depicts innovation. For STS scholars technological determinism does not

²⁵ Ibid.

²⁶ Bijker, W. E., T. P. Hughes, et al. (1987). *The Social construction of technological systems new directions in the sociology and history of technology*. Cambridge, Mass., MIT Press: x, 405 p.





describe in any depth how technology adoption occurs. Technological determinism overly simplifies technology adoption by claiming better technical specifications lead to adoption.²⁷ For example High-Definition televisions will naturally replace traditional televisions,²⁸ because they support a higher viewing resolution. This view of technology adoption by technological determinism creates a very narrow and linear narrative of why technology is adopted.

SCOT attacks technological determinism by showing that various groups, or what Pinch and Bijker call relevant social groups, have their own ideas about what makes a technology “better.” SCOT advocates that the deeper social context that promotes a given technology needs to be discovered.²⁹ For SCOT the relevant social groups are all competing to control the design of the technology. The design of a technology is never predetermined. Instead, each relevant social group has its own idea of what the problem is that the technology is trying solve, and how it should solve it. In most cases the relevant social groups will disagree with each other on how the technology should work. Yet in time one idea of how the technology should function stabilizes, and the other ideas are forgotten. This stable idea becomes the socially accepted notion of how the new technology should look and function.³⁰ SCOT provides a narrative that describes the social context in how a technology is adopted.

²⁷ Smith, M. R. and L. Marx (1994). Does technology drive history? : the dilemma of technological determinism. Cambridge, Mass., MIT Press.

²⁸ NTSC, SECAM, and PAL are the traditional televisions systems.

²⁹ Bijker, W. E. (1995). Of bicycles, bakelites, and bulbs : toward a theory of sociotechnical change. Cambridge, Mass., MIT Press.

³⁰ Ibid.





Actor-Network Theory Literature:

ANT takes a different approach than SCOT in mapping out technological adoption. The STS scholars Michel Callon and Bruno Latour developed ANT to map out the relations between material things and concepts.³¹ ANT is never clearly defined, but it has a set of common themes. The main theme of ANT is the belief that both humans and non-humans can be actors. It becomes the task of the researcher to determine what should be labeled as an actor based on their perceived importance to the network being studied. For ANT these actors come together to form a heterogeneous actor-network. Within this network, ANT focuses on the alignment of interests and the process that translate these interests into stable networks.³²

For ANT a successful network consists of the different actors aligning their interests. Actors align by having their interests translated into the common interest of the network, and by having the actors participate in certain ways of thinking and acting that maintain the network. In the context of my thesis a successful network consist of one that facilitates the adoption of a given technology.

Unfortunately there is no universally agreed upon text that researchers can use in utilizing ANT. ANT has a history of being defined and continually redefined since its inception. Even the main author of ANT, Latour, withdrew his support for a period of

³¹ Latour, B. (2005). Reassembling the social : an introduction to actor-network-theory. Oxford ; New York, Oxford University Press.

³² Ibid.





time,³³ but then afterwards reintroduced it.³⁴ This history of revision has led to incompatibilities between the different versions of ANT.

I address this issue of instability in ANT in my thesis by only selecting and adhering to one version of ANT. The version of ANT I chose is found in Latour's *Science in Action*, and it is the first time ANT appears in its complete form.³⁵ Using this version will let me adhere to the integrity of ANT, but at the same time, since this is the first time ANT appears, it is still malleable enough to be merged with other theories. The later versions of ANT become more complicated and have a narrower focus in terms of application. The version of ANT found in *Science in Action* is the most applicable in terms of analyzing technology adoption, while remaining compatible with theories from other disciplines.

Neoinstitutionalism Literature:

It is due to this malleability and application of ANT that I am choosing it over SCOT to use in my thesis. ANT has a tradition of being used by other disciplines in conjunction with their own theories.³⁶ The interdisciplinary field of Neoinstitutionalism

³³ Law, J. and J. Hassard (1999). Actor network theory and after. Oxford [England] ; Malden, MA, Blackwell/Sociological Review.

³⁴ Latour, B. (2005). Reassembling the social : an introduction to actor-network-theory. Oxford ; New York, Oxford University Press.

³⁵ Latour, B. (1987). Science in action : how to follow scientists and engineers through society. Cambridge, Mass., Harvard University Press.

³⁶ A recent example of another discipline using ANT with its own theories is the work done by Shoib and group in 2006 with their conference paper entitled: "Using Social Theory In Information Systems Research: A Reflexive Account, in Quality and Impact of Qualitative Research."





and especially the business management branch of Neoinstitutionalism, are some disciplines that have tried to incorporate ANT. Geoff Walsham in his work “Actor-Network Theory and IS Research: Current Status and Future Prospects” summarized all the major undertakings in which ANT was incorporated into business management research. Walsham cautions against the instability issue of ANT, but in general he states the utility ANT possess when joined with business management theories.³⁷

It should be noted that the field of Neoinstitutionalism has not fully stabilized yet in terms of there being a general agreement on what counts as neoinstitutionalist research. The main principle behind Neoinstitutionalism is to try to exemplify human behavior by evaluating organizational and institutional structures.³⁸ Many different disciplines have contributed their research to neoinstitutionalist conferences and collections of works. These disciplines range from psychology, to sociology, to economics, to business management.³⁹

Currently within the neoinstitutionalist literature there seems to be a divide between the more qualitative and quantitative disciplines. Some in the more quantitative disciplines, economics and business management, have formed a subgroup called innovation studies.⁴⁰ These disciplines use organizational and institutional structures to explain the human behavior of innovation. Within innovation studies what constitute organizational and institutional structures is never clearly defined which leaves room for

³⁷ Walsham, G. (1997). Actor-Network Theory and IS Research: Current Status and Future Prospects. Information Systems and Qualitative Research: Proceedings of the IFUP TC8 WG 8.2. International Conference on Information Systems and Qualitative Research, London: Chapman and Hall.

³⁸ Scott, W. R. (1995). Institutions and organizations. Thousand Oaks, SAGE.

⁴⁰ Given the unstable nature of neoinstitutionalism, sometimes it is not associated with innovation studies and sometimes it is. Given that I came across innovation studies through references within neoinstitutionalist literature, I have chosen to associate the two together.





a wide range of scholarly contributions. Yet, at the heart of innovation studies is the idea that structural factors can be quantified to create more robust models of innovation.⁴¹

Econometrics Literature:

In regards to the econometrics literature, I will be drawing heavily from works based on event studies. Event studies are a method to study the effects of specific information on capital markets. Craig MacKinlay in his article 1997 entitled “Event Studies in Economics and Finance,” does an overview of the event study literature and methodology. Mackinlay validates the events study by summarizing its use in scholarly research up to that point and showing its practical applications.⁴²

Mackinlay starts off by detailing what goes into an event study. He presents the formulas and data needed to conduct a proper event study. He details all the different variations on the core formulas of an event study, and describes their strengths and weakness. Mackinlay then goes on to summarize how event studies have been utilized by scholars, and what the results of their findings where. Mackinlay’s findings show that the event study methodology was able to properly show the effects of specific information on capital markets.⁴³

One area of research Mackinlay summarized was the work done around financing

⁴¹ Casper, S. and F. v. Waarden (2005). Innovation and institutions : a multidisciplinary review of the study of innovation systems. Cheltenham, UK ; Northampton, MA, Edward Elgar.

⁴² MacKinlay, A. C. (1997). "Event Studies in Economics and Finance." Journal of Economic Literature **35**(1): 13-39.

⁴³ Ibid.





decisions by corporations; in particular how a decision to raise capital in external markets affects a corporation's market capital. He showed that on average corporations would experience a negative return on their capital markets.⁴⁴ An example is if the American company XYZ announces officially that it will be issuing bonds in Europe to raise capital. The event would be the day of the official announcement, and company XYZ's stock price, as listed in the American markets, would be examined to see if there is an effect. If Mackinlay's summarization is correct then company XYZ will experience a drop in its stock price during the time the event took place.

An event study that references Mackinlay's work heavily is a report released by the WTO entitled "Capital Market Responses to environmental performance in developing countries." In this report the authors tested to see if and how capital markets in South America react to the announcement of firm-specific environmental news. The report uses an event study to show that capital markets react positively to the announcement of rewards and explicit recognition of superior environmental performance by increasing a company's market value. On the flip side, the report shows that capital markets react negatively to citizen complaints and recognition of adverse environmental performance by decreasing a company's market value.⁴⁵

The WTO report used articles from major circulating newspapers as its events. So for example company XYZ would experience a drop in its stock price if an article stated it was polluting heavily. The lower stock price translates to a lower market value for XYZ. A lower market value means XYZ has less resources to draw on, and unhappy

⁴⁴ Ibid.

⁴⁵ Susmita Dasgupta, B. L., and Nlandu Mamingi (1998). "Capital Market Responses to Environmental Performance in Developing Countries." Social Science Research Network Working Paper Series: 36.





stockholders. XYZ must address its polluting to raise its market value. In the author's view the event study showed them that capital markets put pressure on companies to grow in environmentally sustainable way.⁴⁶

For this thesis I utilize both Mackinlay's article and the WTO report to develop my event study model. I will not be constructing an elaborate or novel event study. Instead, I will follow closely Mackinlay's outline of how to properly conduct a standard event study, and reference the WTO report and other studies to assure that I always adhere to the criteria of an event study. The above listed econometrics literature is sufficient in enabling me to construct an event study model.

⁴⁶ Ibid.





CHAPTER 3

Actor-Network Theory Model of Innovation

In this chapter I will use Bruno Latour's Actor-Network Theory (ANT) as a framework to combine two different models of innovation to create a more encompassing model. In making my selection I was particularly interested in models that take into consideration institutional and organizational effects on innovation. Hence, I turned to the interdisciplinary study of Neoinstitutionalism. Within Neoinstitutionalism the two models that hold the most promise for my project are "The Hypercube of Innovation" by Allan N. Afuah and Nik Bahram (hypercube model) and "Product versus Process Innovation" by Fariborz Damanpour and Deepa Aravind (PtvPs Model). These two models situated within ANT would fuse into one model that would be more realistic.

The new model, which I will call the Actor-Network Theory model of innovation (AHP model),⁴⁷ will do several things. By incorporating the hypercube model, the AHP model will distinguish between four different kinds of innovation. Also, the AHP model will show that one of these four kinds of innovations is adapted the easiest. The PtvPs model will give the AHP model the ability to determine the environmental⁴⁸ and organizational factors that create the distinctions between innovations. ANT will let me interpret the environmental and organizational factors, emphasized by the PtvPs model, as reasons why this one particular kind of innovation is more easily adopted.

⁴⁷ The acronym AHP stands for (A) Actor-network Theory, (H) Hypercube model, and (P) Product versus Process model.

⁴⁸ I am incorporating institutional effects in the boarder concept of environmental effects.





This model should not be seen as a grand unifying theory of innovation. There are many different aspects of innovation studies that the AHP model does not pertain to. One example is National Innovation Systems (NIS), in which institutional factors are used to explain the innovativeness in a country.⁴⁹ Nor does the AHP model address the micro level issues of why organizations are innovative, or at how to maximize the innovativeness in an organization.⁵⁰

Instead, the AHP model should be used by researchers to understand why a technology is labeled as a certain kind of innovation within the context of a specific organization, and then how this label affects its adoption. Subsequently, the AHP model can depict the difficulties in the adoption of that one technology within that organization, and how one might go about to alleviate these difficulties.

For the purposes of clarity and specificity, in this discussion, I will use Afuah and Bahram's definition of technology as the final output of an innovating entity that is sold in a market. Furthermore, this definition requires technology to have critical components or high-tech equipment as inputs.⁵¹ As in the hypercube model, technology will also be defined as having some subset of the following: (1) it requires some considerable skill or knowledge to use or maintain, (2) the value of the product to the owner increases as more people own it,⁵² and (3) complementary innovations are critical to the diffusion and use

⁴⁹ Steven Casper and Frans van Waarden have a great book out that summarizes all the current NIS works entitled *Innovation and Institutions*.

⁵⁰ Jerald Hage and Marius Meeus have a book out that summarizes all these works as well entitled *Innovation Science, and Institutional Change*.

⁵¹ Allan Afuah and Nik Bahram, "The hypercube of innovation" *Research Policy* 24, (1995): 53

⁵² In other words it possesses positive network externalities that Kartz and Shapiro discuss in their 1985 article entitled: "Network externalities, competition and compatibility."





of the innovation.⁵³ I will use this definition as a more specific notion of what technology is.⁵⁴

The Hypercube Model:

The hypercube model of Afuah and Bahram was built upon existing innovation scholarship. It uses Henderson and Clark's classification system where the central question asked is whether the innovation is overturning existing knowledge of core concepts/components and/or linkages between them.⁵⁵ Depending on the answer, the innovation will be categorized as belonging to one of four groups: radical, architectural, modular, and incremental.⁵⁶

An innovation is classified as radical if the core concepts/components of the innovation and the linkages between them overturn existing ones. An example of a radical innovation would be the automobile when it was first introduced. Both how the user interacted with the linkages and the components of the automobile are radically different from how the user interacted with horses or horse drawn vehicles during that time.

Architectural innovation is when the core concepts and components are reinforced while the linkages among these core concepts/components are changed. An example of architectural innovation would be a new motherboard design that optimizes CPU usage.

⁵³ Allan Afuah and Nik Bahram, "The hypercube of innovation" *Research Policy* 24, (1995): 53

⁵⁴ The upside of using such a narrow definition of technology is that it is well defined for the AHP model, but on the downside things such as social technologies fall out of the model.

⁵⁵ Allan Afuah and Nik Bahram, "The hypercube of innovation" *Research Policy* 24, (1995): 52

⁵⁶ One natural limitation is that all these terms are relative. Any researcher using these terms must be careful to always put them into context.





The motherboard would still use the existing computer components, but would arrange the linkages between them in a different manner.

Modular innovation occurs when the core concepts/components overturned existing ones while the linkages among them remain unchanged. An example of modular innovation would be the read-write heads in disk drives that were replaced by magneto-resistive heads.⁵⁷ Users of the magneto-resistive heads see a dramatic improvement in terms of the amount of information that they can store, but the user is not forced to change any other computer components.

Incremental innovation is when the core concepts/components were reinforced while the linkages among the concepts were unchanged.⁵⁸ An example of incremental innovation would be a faster CPU.⁵⁹ The new CPU would take the place of the old CPU without the need of changing anything else in the computer; all the new CPU would do is to reinforce the computer by making it faster.

The hypercube model puts these four groups of innovation into a specific context. It looks at how a single innovation impacts four different groups: the innovating entity, suppliers of components, customers, and complementary innovators.⁶⁰ This is what sets this model of innovation apart from its contemporaries. This model specifically recognizes that innovation is a concept that changes from group to group.⁶¹ Granted, the

⁵⁷ Jerald Hage and Marius Meeus, *Innovation, Science, and Institutional Change* (New York: Oxford University Press, 2006), 25

⁵⁸ Allan Afuah and Nik Bahram, "The hypercube of innovation" *Research Policy* 24, (1995): 52

⁵⁹ For this example to work the architecture of the new CPU needs to be the same as the old. (i.e. They are both x86 or SPARC chips)

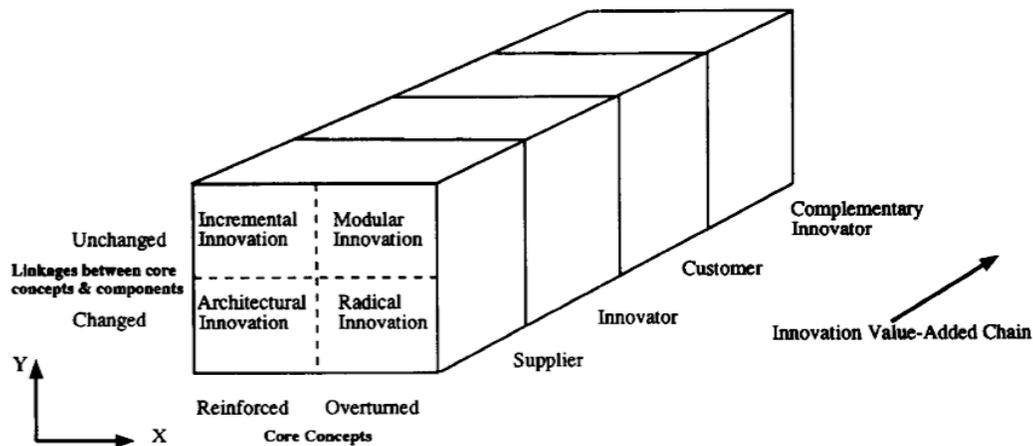
⁶⁰ Allan Afuah and Nik Bahram, "The hypercube of innovation" *Research Policy* 24, (1995): 54

⁶¹ One can even say the "Innovation" is a social construct.





hypercube model has a very business-oriented view of innovation, nevertheless, it may still be used as a starting point for a more realistic interpretation of innovation. Below is a figure the authors used to illustrate their model.



Allan Afuah and Nik Bahram, “The hypercube of innovation” *Research Policy* 24, (1995): 53

The hypercube model is schematized as a four-dimensional grid with each grid representing one of the four kinds of innovation. Four of these grids are lined up in a row to make the value-added chain. The value-added chain starts at suppliers, continues to innovator, then to customer, and ends at complementary innovators.⁶² In the view of the authors, as the innovation proceeds through this chain, each group adds further value to the innovation. This is a very linear idea of how innovation is created. The authors barely address how these different groups relate to each other or how their actions might affect one another. Below is an illustration of how the hypercube fits together.

⁶² Allan Afuah and Nik Bahram, “The hypercube of innovation” *Research Policy* 24, (1995): 55



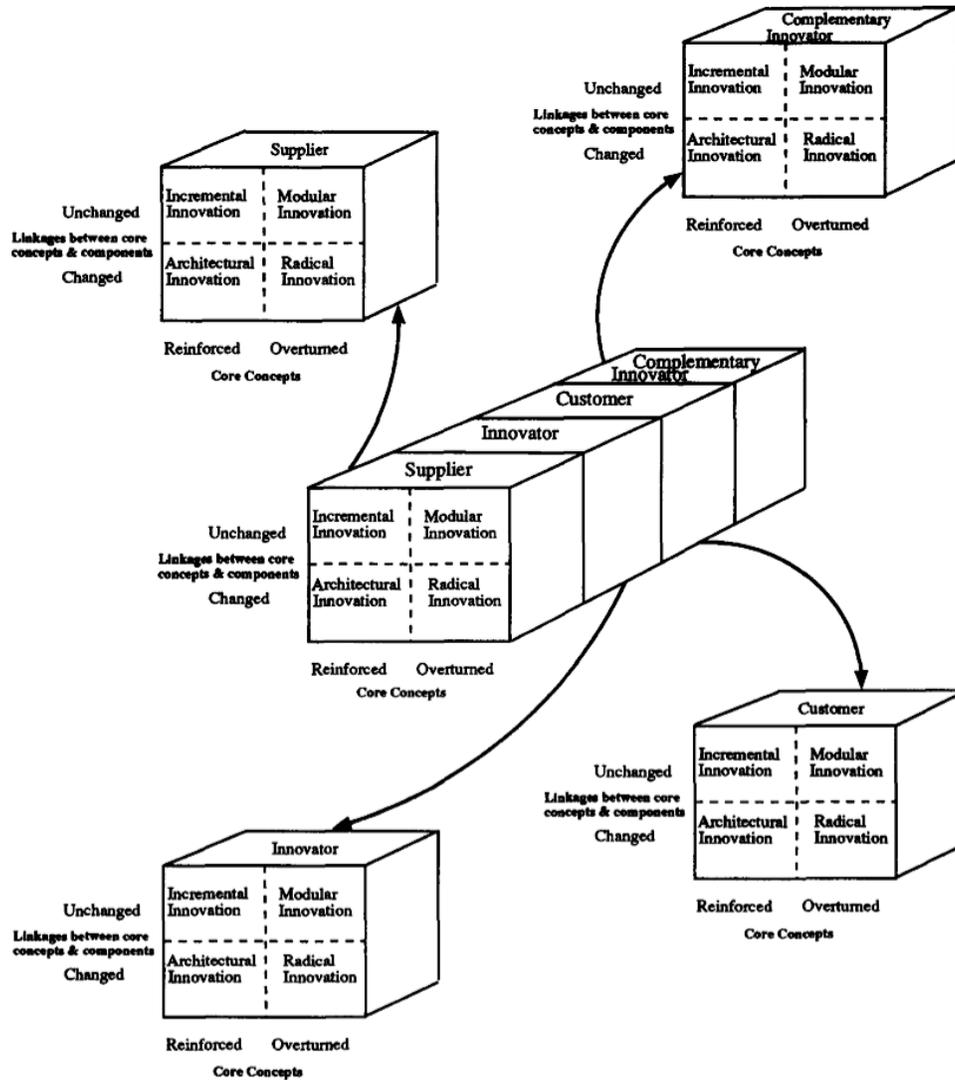


Fig. 2. The hypercube of innovation exploded to show the various faces that an innovation can assume along the innovation value-added chain.

Allan Afuah and Nik Bahram, "The hypercube of innovation" *Research Policy* 24, (1995): 54

The authors use lists of questions to examine each group on the value-added chain to determine into which of the four innovation dimensions the technology falls. For example, depending on the innovating entity, the questions posed are: does the innovation enhance or makes obsolete core concepts from previous innovations, does the innovation enhance or destroy previous knowledge of linkages, do the technological components





change or stay the same, does the innovation enhance or destroy other competencies,⁶³ does the innovation enhance use of previous technologies or cannibalize them, can the innovation use or not use previous complementary technologies, and in terms of institutional support, can the innovation receive any government or other institutional research subsidies?⁶⁴ The other groups have their own similar list of questions, but since I will later be using the PtvPs model to reconstruct this part of the hypercube model I will not cover the other lists in any detail.

Significantly, these questionnaires determine what kind of innovation a technological artifact is for a group. There are no set rules on how to use these lists of questions. The authors never state that if you answer yes to this and no to that then it is this kind of innovation. The lists seem to be more of a guide in helping researchers determine which of the four kinds of innovation a group is experiencing. The lists also rarely take into account of other factors such as environmental or organizational structures.

Next, the authors turn the cube representation into a two-dimensional map called the green-red zone map. The map charts how the innovation affects the different groups through the value-added chain. The x-axis lists the different groups in the value-added chain and the y-axis uses the previous ordinal scale, of incremental = 1, modular = 2, architectural = 3, and radical = 4, with intensity of adoption increasing from incremental to radical. Below is an illustration of the green-red zone map.

⁶³ What the authors mean here by competencies is skills and knowledge from the previous innovation.

⁶⁴ Allan Afuah and Nik Bahram, "The hypercube of innovation" *Research Policy* 24, (1995): 55



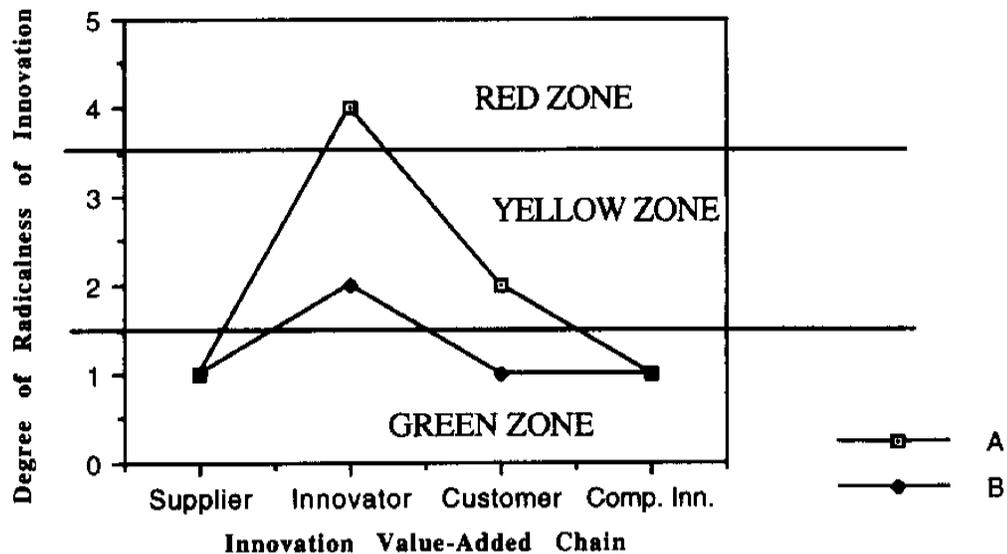


Fig. 3. The green–red zone map.

Allan Afuah and Nik Bahram, “The hypercube of innovation” *Research Policy* 24, (1995): 58

The above illustration depicts two innovations, A and B. Innovation B would be adopted more easily than innovation A because innovation B’s line is more in the green zone than innovation A’s. The main difference is that innovation B is modular for the innovator whereas innovation A is radical for the innovator. The authors are unclear as to how to interpret the yellow zone. What the authors focus on most are the dangers of the red zone. The authors state that innovations should not be pursued if any organization in the value-added chain is in the red zone; especially if it is the customers. The authors have four exceptions of when it is permissible to enter into the red zone for customers.⁶⁵

The first is when the price/performance ratio of the innovation for customers outweighs the destruction of both the competence of core concepts/components and the linkages the technology is tied to. An example given is when the older technology has

⁶⁵ Allan Afuah and Nik Bahram, “The hypercube of innovation” *Research Policy* 24, (1995): 57





reached is physical limits and a radical innovation is required to overcome this. The second is when the innovation is creating new markets where customers have not yet built any competence towards a technology and there are no linkages to overturn. The example given is how the disk operating system (DOS) was not destroying any competence or linkages when it was introduced in the personal computer (PC) market, because the PC market was a new market. The third is when complementary innovations let customers keep their competence and linkages. For example, software that runs Windows programs on Linux operating systems lets customers keep their competence and linkages even after adopting Linux. The fourth is simply when institutions mandate the adoption of an innovation.

Thus, the hypercube model distinguishes four kinds of innovation, and also states that there are four groups that can be affected by an innovation. Then, using a tailored list of questions one can determine which of the four kinds of innovation a group is experiencing. The underlining assumption of the model is that innovations determined to be incremental are adopted more easily by a group. The hypercube model does not advocate that all incremental innovations will be adopted, and likewise that radical innovations will never be adopted. The hypercube model advocates that each group needs to be examined in terms of how it interacts with a technology, and the easier it is for a group to utilize a technology, the easier it is for that group to adopt that technology.

Where the hypercube model falls short is that it paints too simple a picture of the groups involved with a particular innovation. All suppliers are lumped into one group as if all innovations only had one supplier; the same goes for the customers and complementary innovations. The relationship the innovating entity has with the other





groups is barely taken into consideration. The tailored lists that determine the kind of innovation fail to adequately take other factors into consideration, especially organizational structures or environmental factors.

To illustrate some of the shortcomings of the hypercube model I will use it to analyze how consumers would categorize Sony's current video game console the Playstation 3 (PS3). Analyzing the PS3, the hypercube model would state that the consumers would not have to alter their behavior in terms of using the device, but the hardware inside the device is radically different than from previous generations. The hypercube model would conclude that the PS3 is a modular innovation for consumers, and as such will not face any great difficulty in being adopted.

Where the hypercube model fails within the example of the PS3 is that it does not take the context of the consumer into account when analyzing the device. The consumers will not have to alter their behavior in terms of using the device, but they will have to greatly alter their behavior to acquire the device. The cost of a basic PS3 at its launch was 600 dollars. The cost of the PS3 is vastly higher by almost a factor of two compared to any other console of its generation. This price difference proved to be a radical shift for consumers in terms of what they were willing to pay for a video game console. The simple approach of the hypercube model only looks at how technology is used, and not the broader social context of how the technology is viewed. Using the ANT to combine the hypercube model with the PtvPs model would correct these kinds of shortcomings. As the AHP model will show in the next chapter, the PS3 would be categorized as a radical innovation for consumers if the broader social context in which the PS3 is situated in were taken into account.





The Product versus Process Model:

The PtvPs model differs much from the hypercube model. Damanpour and Aravind created the PtvPs model more as a guide for future research in the field than as a tool for understanding an event. The PtvPs model tries to explain why organizations either create product innovations or process innovations. Specifically, the PtvPs model strives to show how external factors lead either to product or process innovations. Below is an illustration of the PtvPs model.

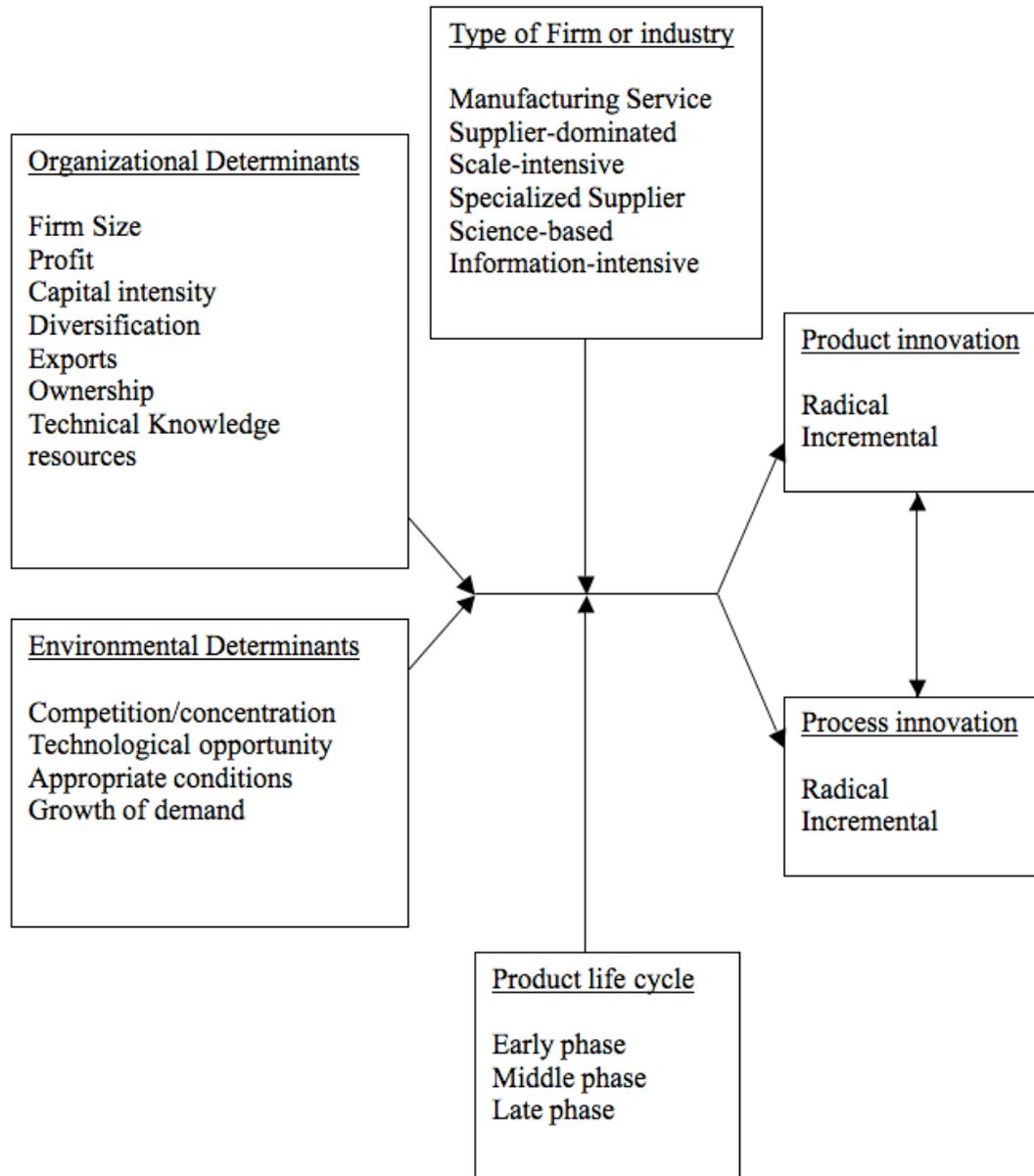
The authors define product innovation as either new products or services introduced to meet the needs of an external user or market. Process innovation is defined as new elements introduced into an organization's production or service to produce a product or render a service.⁶⁶ Thus a robot that makes cars is a product innovation for the company selling it and a process innovation for the company buying it.

Process innovation is a very broad concept. Even a minor change in an organizational procedure can be seen as a process innovation. A secretary's decision to only answer emails after lunch could be seen as a process innovation. When the authors, or most innovation scholars for that matter, talk about process innovation they really are focused on cost cutting, automation, outsourcing, or in other words, process innovations that specifically deal with manufacturing a product.⁶⁷

⁶⁶ Jerald Hage and Marius Meeus, *Innovation, Science, and Institutional Change* (New York: Oxford University Press, 2006), 60

⁶⁷ The group of innovation scholars that works on organizational learning does use a wider concept of process innovation.





Innovation, Science, and Institutional Change, Pg 58

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The PtvPs model guides researchers by listing the different variables that need to be controlled for an econometrics model that tries to measure the likelihood of either a product or process innovation being pursued by an organization. According to the authors, the items listed in the organizational and environmental determinants boxes can





all be quantitatively assessed. For instance, firm size can be measured in terms of the number of employees. Market share can be assessed by total sales or as a ratio of firm's employment to industry employment. Technical knowledge can be measured as the ratio of employees with an academic degree to all employees, the proportion of technical employees, or the presence of technical groups.⁶⁸ The researcher then selects specific variables to look at, from both the type of firm or industry box and the product life cycle box. For example, a researcher could look at an organization in an information-intensive industry whose product is in the early phase of the product life cycle. Then, taking into account all the organizational and environmental determinants, the researcher should be able to create an econometrics model to predict if that organization will emphasize product or process innovations.

Overall, the PtvPs model shows that organizational and environmental determinants, type of firm or industry, and product life cycle all influence whether a product innovation or a process innovation is pursued. The PtvPs also makes a distinction between radical and incremental innovations, though it is a simpler notion compared to that of the hypercube model. In addition, the model points to how product and process play off each other in determining what specific kind is emphasized.

All these different factors paint a complicated yet simple picture at the same time. The PtvPs model is complicated in that it has so many factors that it becomes unclear what is affecting what. Just noting that product and process innovations influence each other can lead to a circular argument where one does not know if the product or the process caused the other. The model is simplistic because the items in the boxes tend to

⁶⁸ Jerald Hage and Marius Meeus, *Innovation, Science, and Institutional Change* (New York: Oxford University Press, 2006), 60





be very general. For example, the distinction that the PtvPs model makes between radical and incremental innovation does not take into account the nuances that the hypercube model does. The PtvPs model breaks down the different types of firms and industry without explaining how they were categorized. How can you differentiate an information-intensive industry from a science-based industry? Wouldn't the distinction hinge on one's definition of science and so the distinction can be seen as arbitrary? Also, the product life cycle is not put into any kind of context. A product can be in the early phase for an organization but in the late phase for the industry as a whole. A product can be in an early phase for an industry but in the middle or late phase for customers. An example of this could be electric cars. The electric car is in the early phase of development for the industry but the concept of how to use cars has been around a long time for customers; so in effect, the electric car might be a middle or late phase development for customers.

To illustrate some of the shortcomings of the PtvPs model I will setup the variables the PtvPs model would evaluate in determining why Sony's created the PS3 as the kind of innovation it is. In the best-case scenario, the PtvPs model would collect information on Sony's firm size, profit, capital intensity to make a PS3, and the other variables listed in the chart above that can be quantified. After these variables are collect an econometrics model would be run to see the likelihood that either a radical or incremental innovation would be created.

Where the PtvPs model fails within the example of the PS3 is that it does not take into account other powerful forces that cannot be quantified. For example historical or cultural factors are not be taken into consideration by the PtvPs model under organizational and environmental determinants. In this example Sony's past history with





the success of Playstation 1 and 2, and its own internal engineering culture, played a large role in designing the kind of innovation the PS3 would be. The PtvPs model does a good job in accounting for external factors in innovation research, but other factors that are not easily quantified still need to be accounted for to have a more holistic sense of innovation.

What I want to take from the PtvPs model is its useful concept of how organizational and environmental determinants affect the outcome of what kind of innovation is produced and combine this notion with the hypercube model. The other portions of the PtvPs model can be re-conceptualized to work within the new AHP model. The glue that will let me put these two models together is the ANT.

Actor Network Theory Model of Innovation:

The particular flavor of ANT that I will use is the one found in Bruno Latour's *Science in Action*. I will use this version of the ANT because this is the first time that the theory appears in its complete form while still remaining malleable. To clarify, the ANT is not really a theory; even though it is often referred to as such. ANT is more of a framework that can be used to make sense of the world. At its core, ANT is guided by six principles. I will discuss these six principles below and some other key concepts of ANT to slowly construct the AHP model of innovation.

(First principle) The fate of facts and machines is in later users' hands; their qualities are





thus a consequence, not a cause, of a collective action.⁶⁹

The first principle requires the collective action of an organization to define the qualities of innovation. This concept is already reflected in the hypercube model since each organization in the value-added chain defines innovation in one of four ways. This is the first element I will draw into the AHP model. Organizations define the quality of innovation, but the quality can only be one of the four kinds of innovation from the hypercube model; that is either: incremental, modular, architectural, and radical.

Two concepts in ANT that need to be defined before continuing are actant and actor-network. Actant will be defined as any element that makes other elements dependent on it and translates its will into its own language. Common examples of actants that Latour uses include humans, organizations, texts, and technical artifacts; two other examples that I will flesh out later are environmental forces and organizational structures.⁷⁰

According to ANT, actants all have interests. To most people it sounds strange stating that non-human actants, like texts or technical artifacts, have interests. The reason for this terminology is because ANT assumes that all elements, be they human or non-human, can be described using the same terms; this is called generalized symmetry. The rationale for this is that the differences between human and non-human will become apparent as the networks are being constructed, but it should not be presupposed from the beginning that there is a difference. It should be noted that interests is defined a little

⁶⁹ Bruno Latour, *Science in Action* (Massachusetts, Harvard University Press, 1987), 259

⁷⁰ Bruno Latour, *Science in Action* (Massachusetts, Harvard University Press, 1987), 84





more vaguely so as to accommodate non-human actants, but it still sounds odd to some to say non-human actants have interest.⁷¹

One way around this is using the word purpose instead of interest. Human actants can still have a purpose, but it becomes easier to conceive of non-human actants as having a purpose. For example, the purpose of a text could be to spread, technical artifacts could be to survive, environmental forces could be to mold events, and organizational structures to shape behavior. Regardless, if it is the word purpose or interest that is used the concept is still the same.

This leads to the second concept of the actor-network. Since all actants have a purpose, actants try to convince other actants to align their purpose with their own. When this alignment occurs an actor-network is created. So an actor-network is a heterogeneous network of aligned purposes.⁷²

Actor-networks can also be actants on a broad level. For example, a CEO can gather employees and other resources to form a company. The CEO is an actant with a purpose who gathers other actants by aligning their purpose with his own to form a company. The company then becomes an actant with a purpose itself. Depending on how strong a purpose the company has, it can last long after the founding CEO has left. So from a macro level organizations can be seen as actants, but from a micro level the organization can be broken up into its individual actants.

The concept of actor-networks can be seen in the hypercube model as well. Supplier, innovating entity, customer and complementary innovators can all be

⁷¹ Bruno Latour, *Science in Action* (Massachusetts, Harvard University Press, 1987), 108

⁷² Bruno Latour, *Science in Action* (Massachusetts, Harvard University Press, 1987), 180





interpreted as actor-networks. The weakness with the hypercube model is that it assumes there are exactly four actor-networks in every case. The hypercube model cannot adjust to cases, for example, where there are multiple suppliers that define the qualities of innovations differently for each other. Also, you have Internet companies like Google that have no suppliers for most of their projects.⁷³ In terms of customers, the hypercube model paints them as being unified. The hypercube model cannot differentiate between niche customers and new customers and how they might define the innovation differently. The hypercube model is at a loss if an actor-network does not fit into any of its four groups; for example, distributors. Since Wal-Mart is a huge distributor other actor-networks must take seriously any of its demands. The hypercube model, as it is now, cannot analyze Wal-Mart's relationship with other actor-networks.

The second element that I will add to the AHP model is the concept of the actor-network, but unlike the hypercube model, I will leave it to the discretion of the researcher to determine who the major actor-networks are for each case. Certain actor-networks can be grouped together and categorized as suppliers or customers for ease of understanding. I will, however, limit the notion of actor-networks to mean either organizations or cluster of organizations.⁷⁴ Consequently, the concept of actant would be limited as well. Actants are defined as being part of a major actor-network and being relevant to the innovation being studied.

The reason for these limitations is that they will make the AHP model more manageable. For example, if one were to apply ANT without these limitations to an

⁷³ In this case one could salvage the hypercube model by saying that employees supply code, but it seems that would be warping the essence of the hypercube model.

⁷⁴ Customers can be seen as a cluster of organizations, that in some cases have nothing in common.





innovation like Sony's Playstation 3 (PS3), they would create an enormous web of actor-networks with an even larger number of actants. Sony is a huge, multinational company with many departments possibly having input in the creation of the PS3. Within the raw form of ANT, Sony would be seen as an actor-network. Each of Sony's departments and sub-departments would be seen as actor-networks too. Each of these departments would have an array of actants that need to be accounted for, and this is just for Sony. Many companies were involved in the creation of the PS3. Just the suppliers alone numbered in the dozens and ranged from manufacturing firms that produced small plastic parts to multinational companies that produced advanced circuitry. To use the raw form of ANT to map out all the actor-networks and actants involved in creation of the PS3 would require a vast amount of time and ultimately might degenerate into an unmanageable project.

If the PS3's suppliers were looked at with the AHP model, then there would be only two major actor-networks, IBM and NVIDIA. These limitations do hamper the completeness of the picture that the AHP model tries to demonstrate because the AHP model is geared to be a more practical tool that looks specifically at innovation.⁷⁵ The limitations placed on the AHP model are there to balance manageability and understanding while still maintaining the essence of ANT. By limiting actor-networks at the organizational level, the AHP model can still put innovation in its context for a given organization, and it can list the key actants involved in creating that context.

(Second Principle) Scientists and engineers speak in the name of new allies that they have

⁷⁵ Using the raw form of ANT would lead to some valuable insights, but would require a great deal of more time than AHP model.





shaped and enrolled; representatives among other representatives, they add these unexpected resources to tip the balance of force in their favor.⁷⁶

The second actor network theory principle stipulates that an actant enrolls the other actants into its own actor-network in tipping the balance in its favor. To fully understand what the ANT is stating here, the concepts ‘translation’, ‘focal actor’, and ‘obligatory passage point’ need to be defined.

Translation is the process in how an actor-network is created. Translation involves a focal actor first defining a purpose for other actants that is consistent with its own. What the focal actor defines is called the obligatory passage point (OPP). Then the focal actor convinces and enrolls the other actants into its own actor-network.⁷⁷ The OPP holds the purpose of all the other actants in place. By defining the OPP the focal actor makes itself indispensable to the other actants. The focal actor also creates clarity in ANT because it gives us a single actor to focus on and a single vantage point to view the process of translation.⁷⁸ So the second principle states that a focal actor, through the process of translation, can tip the balance in favor for an OPP it defined.

I will adopt the second principle into the AHP model, but with two limitations. The focal actor must be one of the major actor-networks and the OPP is the technological innovation that is being studied. In fact, for the remainder of this paper the term OPP is

⁷⁶ Bruno Latour, *Science in Action* (Massachusetts, Harvard University Press, 1987), 259

⁷⁷ I am summing up Problematization, Interessement, and Enrollment from Actor-network Theory without using their specific terminology.

⁷⁸ Callon, Michel. “Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay” *J. Law, Power, action and belief: a new sociology of knowledge*. London, Routledge, 1986





interchangeable with the term innovation. So a researcher will first map out all the major actor-networks involved with a particular innovation. The researcher will then designate one of the actor-networks to be the focal actor, usually the innovating entity.⁷⁹ Put in different terminology, the focal actor is trying to sell the OPP to different groups. The focal actor is trying to convince the suppliers to make parts for the OPP, the customers that they have to buy the OPP to better their lives, the other organizations to create complementary innovation for the OPP and so forth. The focal actor ultimately tries to enroll the other actor-networks into what I will call a System. I use the word “System” mainly for clarity. Within ANT what I call “System” would be nothing more than another actor-network. Yet, since I limited what an actor-network can consist of, I mostly use the new terminology of a System to be consistent within the AHP model.

(Third principle) We are never confronted with science, technology and society, but with a gamut of weaker and stronger associations; thus understanding what facts and machines are is the same task as understanding who the people are.⁸⁰

The third principle in ANT stipulates that we are never confronted with innovation, but with a range of weaker and stronger associations. For the AHP model, radical innovations are the weakest associations and incremental are the strongest associations. The theoretical reasoning behind this is that the focal actor will have a harder time aligning the purpose of actor-networks that define the qualities of the OPP as

⁷⁹ Both Intel in the chip market, and recently Walmart with green technologies, have shown that suppliers or distributor can play the role of an OPP.

⁸⁰ Bruno Latour, *Science in Action* (Massachusetts, Harvard University Press, 1987), 259





radical. Equally, it is easier for the focal actor to align the purpose of other actor-networks when they define the OPP as incremental. All this holds true for the focal actor itself. If the focal actor defines the OPP as radical it is harder to align its own purposes with it. The stronger associations that an OPP has the more likely it is to be adopted. The actants of the weaker associated actor-networks can be examined to see if anything can be changed to create a stronger association with the OPP.

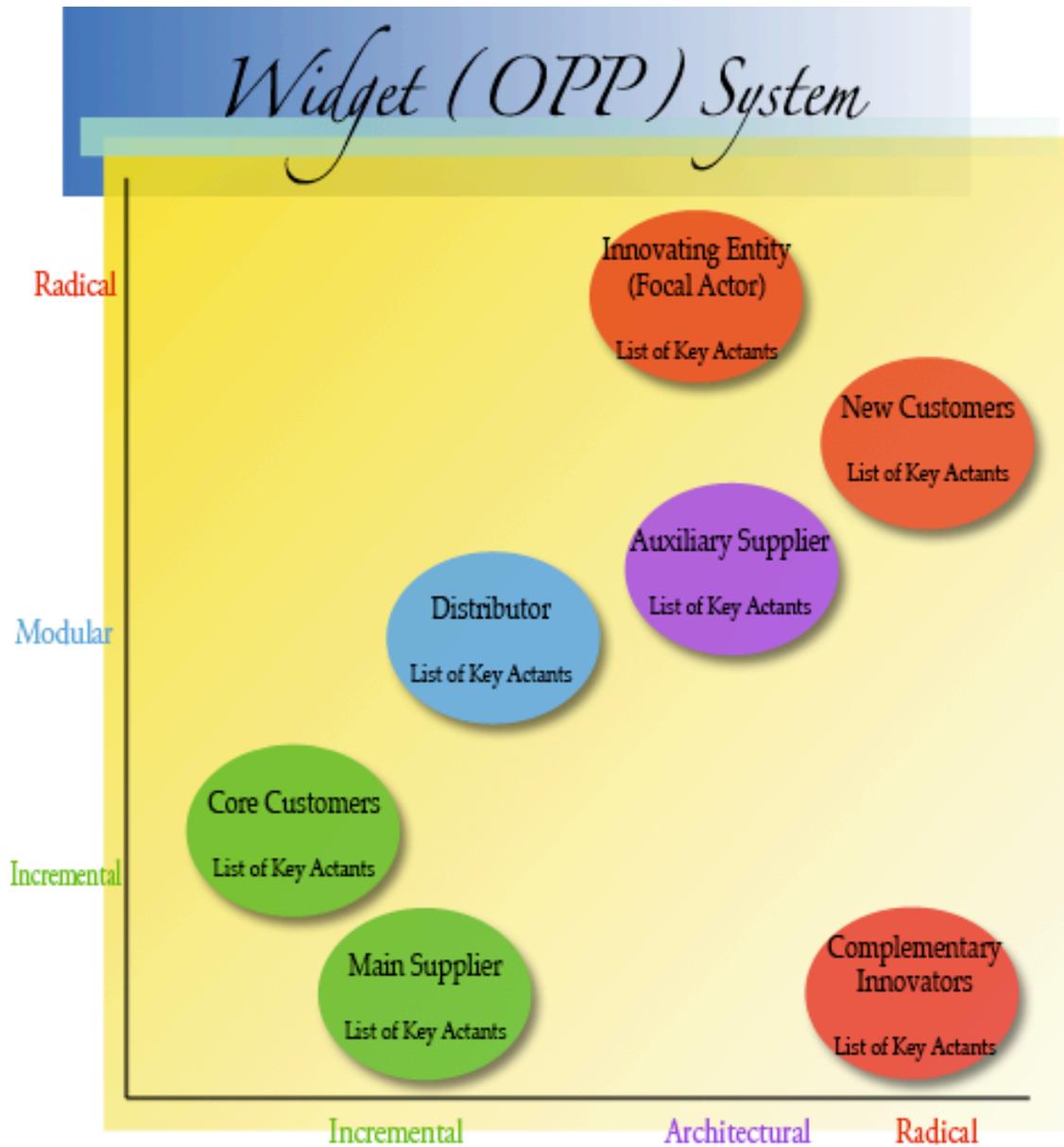
The AHP model can be used to create a chart similar to the hypercube model's green-red zone map. Below is an example of what an AHP Model chart would look like. Overall, the chart shows that the widget will face some difficulties in being adopted. The key list of actants for the focal actor, new customers, and the complementary innovators need to be examined to see if the OPP can be translated in any other way so as to create a stronger association and tip the balance in favor of the OPP being adopted.

As the below illustration further shows, the AHP model creates a snapshot of the actor-network. Initially all the actor-networks that are important to the OPP are listed. If customers are not yet introduced to the OPP then they would not initially appear in the researcher's system. As the list of actants, which determine what kind of innovation an actor-network is, experience changes, the system can be updated to reflect these changes. A supplier might be experiencing a radical innovation. Then the focal actor might either address some of the supplier's key actants or redefine the purpose of the OPP so that the supplier will experience a modular innovation. The researcher can update the system to reflect these changes. The AHP model creates a dynamic system that can be updated to include new important actor-networks as they are introduced to the OPP, or for example the kind of innovation customers are experiencing can be updated as their experience





changes.



(Fourth principle) The more science and technology has an esoteric content the further the extend outside; thus, ‘science and technology’ is only a subset of technoscience.⁸¹

⁸¹ Ibid.





The fourth principle does not directly relate to the AHP model. For ANT the fourth principle simply breaks down any pre-existing ideas of science and technology. ANT does not interpret science differently from technology. Both can be reconceptualized using the same terminology from ANT. This principle lets the ANT be utilized for all activities involving technoscience. This relates to the AHP model in that if, in the future, I use a broader definition of technology, I will not be undermining the essence of ANT.

(Fifth principle) Irrationality is always an accusation made by someone building a network over someone else who stands in the way; thus, there is no Great Divide between minds, but only shorter and longer networks; harder facts are not the rule but the exception, since they are needed only in a very few cases to displace others on a large scale out of their usual ways.⁸²

The fifth principle would reinforce the notion that actants determine how an actor-network defines the innovation, and the principle would further add that the actants naturalize the outcome in the end. This means that the technical specifications of innovation are just one actant and that there are other actants that are working to determine the kind of innovation for an actor-network, and these other actants can ultimately naturalize the adoption of a technology.

An overly simplified example could be seen in the current MP3 player market.

⁸² Ibid.





Currently Apple's iPod has the largest market share, but there are other MP3 players that have technical specifications that are superior to the iPod. 'Superior' in terms of more storage capability, longer battery life, cheaper price and a wider range of music format compatibility. Despite their advantages vis à vis the ipod, these other MP3 players are still slow to be adopted by customers. The reason is that these other MP3 players can be seen as radical innovations in comparison to the iPod. Apple has created a culture where people feel like they have to have an iPod to fit in. Anyone owning another MP3 player, regardless of its technical specifications, can be seen as an outsider to this Apple culture.

Apple, in essence, created a key cultural actant for customers. This actant determines that the iPod as an incremental innovation, because people who buy it feel like they fit in. On the other hand, this actant determines other MP3 players as radical innovations, because people believe if they bought one of these MP3 players they would not fit in and they would have to constantly explain why they did not just buy an iPod. Apple's cultural actant has naturalized the outcome of adopting an iPod. Technical specifications are just one actant in a long list of actants that determine the kind of innovation any particular actor-network is experiencing, and in the end actants can naturalize the outcome of a technology being adopted.

(Sixth principle) History of technoscience is in a large part the history of the resources scattered along networks to accelerate the mobility, faithfulness, combination and cohesion of traces that make action at a distance possible.⁸³

⁸³ Ibid.





The sixth, and final, principle can be used to justify incorporating the PtvPs model into the AHP model. The sixth principle can be seen as stipulating the importance of organizational and environmental actants in determining the kind of innovation that an actor-network is experiencing. For example, organizational traditions or a country's past can be seen as important actants for actor-networks. Specifically, video game consoles are not as rapidly adopted in South Korea. Two Japanese companies, Nintendo and Sony, are the largest makers of video game consoles. Therefore video game consoles are seen as Japan's products in South Korea. Koreans have not forgotten Japan's actions toward them during and before World War II and consequently, some Koreans view buying Japan's products as too radical.⁸⁴ This environmental actant has determined that video game consoles are radical innovations for many Koreans.⁸⁵ The same can be said about the pride some American feel in buying American products. American companies that are able to tap into this actant can create a stronger association between their innovation and those customers. The focal actor needs to be aware of organizational and environmental actants, and whenever possible, utilize them to create stronger associations between actor-networks and the OPP.

In the next chapter I will return to the PS3 example and show how the AHP model can account for factors the other two models alone would miss. I will demonstrate how there are powerful historical and cultural actants inside Sony's actor-network. These actants are not easily quantifiable so the PtvPs model would not be able to account for

⁸⁴ . "Let the Video Games Begin." Retrieved 4/14, 2008, from http://www.nytimes.com/packages/khtml/2006/10/08/arts/20061008_SCHIESEL_AUDIOSS.html?adxnml=1&adxnmlx=1160937231-DAc21c6JEjFsTF5xznSVbw.

⁸⁵ This is further evident by the fact Nintendo waited a full year to release the Wii video game console in South Korea after successfully releasing the Wii throughout the rest of the world. Nintendo's press release regarding its Korean launch of the Wii can be found here: <http://gonintendo.com/?p=40152>.





their influence on the PS3. These actants greatly limited the kind technological artifact the PS3 could be, and as such, these actants led Sony to create a technology that consumers would categorize as a radical innovation. The Hypercube model would interpret the consumers experience with the PS3 as a modular innovation, but the hypercube model does not account for the broader social context in which the consumers interact with the PS3. Ultimately the AHP model will demonstrate how Sony's historical and cultural actants limited Sony to designing the PS3 in a way that guaranteed it would meet resistance in its adoption by consumers.

Summary:

The AHP model borrows the essence of the hypercube model in that actor-networks define innovation in one of four ways and that the stronger the association an actor-network has with the OPP the more easily it will be adopted. The AHP model can be seen as more dynamic compared to the hypercube model. Where the hypercube model is limited to looking at just suppliers, innovating entity, customer and complementary innovators, the AHP model can look at as many actor-networks as need be. Where the hypercube model sees innovation as a linear process starting from suppliers and ending at complementary innovators, the AHP model creates a dynamic system where the relationship actor-networks have with each other can be continuously updated as the OPP becomes finalized.⁸⁶ Where the hypercube model has a narrow list to determine the kind of innovation a group is experiencing, the AHP model utilities the more pragmatic

⁸⁶ Or as Latour would say as the OPP becomes black boxed.





concept of actants in determining what kind of innovation an actor-network is experiencing.

Borrowing from the PtvPs model organizational and environmental factors should be seen as important actants in determining what kind of innovation an actor-network interprets an innovation to be. The rest of the PtvPs model, such as the type of firms or product life cycle, would be differentiated by the tailored list of actants for each actor-network.⁸⁷ For example, the list of key actants would be different for a specialized supplier than for a scale-intensive supplier and, in addition, the list of actants would be different for an actor-network in the early phase of a product life cycle than in the late phase.

Ultimately, Latour's ANT created the framework for the AHP model. The hypercube model created the boundaries for the AHP model, and the PtvPs model provides a matrix for specifying and categorizing the different actants that define innovation for an actor-network.

⁸⁷ This aligns well with the concept of generalized symmetry from ANT.





CHAPTER 4

Example of AHP Model at Work

Given the limitations of a Master Thesis I cannot utilize my Actor Network Theory model of innovation (AHP model) in its entirety. Instead what I will do in this chapter is provide an example of how one actant within one actor-network can affect the adoption of a given technology. This example will be adequate in demonstrating the utility of the whole AHP model, and it will provide enough insight so as to be able to make an educated guess on the success of the technology under investigation. I will test this educated guess in the next chapter using an event study from econometrics.

The second thing I will do in this chapter is demonstrate how other theories can be incorporated into the AHP model. I will use frame theory to explain the intricacy of Sony's relationship with its customer. ANT has its own mechanisms for examining the micro level of behavior I detail in this chapter, but by utilizing frame theory I am able to further demonstrate the robustness and flexibility of the AHP model. In addition, by using this other theory I plan on laying the groundwork to incorporate other theories into the AHP model in the future.

The specific technology that I will look at is Sony's Playstation 3 (PS3). The two actor-networks involved in this example are Sony and preexisting video game consumers, which I will just call consumers from this point on. Sony is also the focal actor, and I will detail how it tries to define the PS3, which can also be called the obligatory passage point (OPP), to convince consumers to adopt it. The specific actant that I will examine is the institutional frames that are a part of Sony's actor-network, and how this actant forced





Sony to define the PS3 in a way that made it a radical innovation for consumers.

Frame Theory:

The concept of institutional frames comes from the work done by Donald Schön and Martin Rein in their book entitled *Frame Reflection*. Institutional frames are a subset of the broad concept of action frames. The authors define action frames as the tacit beliefs that influence policy positions.⁸⁸ In conjunction with developing the concept of action frames, the authors also developed the notion of policy conversation. For the authors, in a policy conversation, designers interact with stakeholders while being limited by their respected action frames. The authors developed these ideas to explain how government policy is designed. I will apply these concepts to corporate policies, and demonstrate how action frames, specifically institutional frames, constricted the behavior of Sony.

Schön and Rein's concepts are well situated to work within the AHP model. Given the versatility of the concept actant that I detailed in the previous chapter,⁸⁹ the concepts of the various action frames the authors construct can be reconceptualized as actants. In addition, policy conversation can be reconceptualized as the process in which the focal actor tries to continually define the OPP as a way to enroll other actor-networks. So, within this chapter I will illustrate how Sony's institutional frames confined the

⁸⁸ Schön, D. A. and M. Rein (1994). Frame reflection : toward the resolution of intractable policy controversies. New York, BasicBooks.

⁸⁹ Latour, B. (1987). *Science in action : how to follow scientists and engineers through society*. Cambridge, Mass., Harvard University Press.





policy conversation in such a way that the PS3 became a radical innovation for consumers.

For Schön and Rein, action frames create boundaries that limit what actions an organization can take. Action frames do this by informing the organization what counts as policy practice. For instance, looking to a higher power for a solution to a problem might not be an accepted practice in one organization, but might be accepted in another. The authors are clear in distinguishing between rhetorical and action frames. Rhetoric refers to the convincing use of story and argument in policy debate. Action frames, on the other hand, refers to the frames that inform policy practice. Sometimes rhetoric and action frames can overlap. The authors point out that, more often than not, the language used in convincing other members of the organization differs from the frames that are implicit in the agreements that determine the content of laws, regulations, and procedures.⁹⁰

The concept of action frames breaks down into three levels: policy, institutional, and metacultural. Policy frames are situated inside institutional frames, which themselves are situated inside metacultural frames. Policy frames draw on institutional frames to construct their boundaries and likewise institutional frames draw on metacultural frames to construct their boundaries. A quick example of this would be a shaman that wants to create rain to alleviate a drought. The shaman can perform a ritual that calls on the gods of his people to create rain. The gods the people believe in are part of the metacultural frames. The institutional frames construct the rituals performed by the shaman, and the decision to call on the gods to alleviate the drought is a policy frame.

⁹⁰ Schön, D. A. and M. Rein (1994). Frame reflection : toward the resolution of intractable policy controversies. New York, BasicBooks.





Sony's Institutional Frames:

I have chosen to only focus on Sony's institutional frame level for this chapter. The other two action frame levels are relevant, and in a complete demonstration of the AHP model should be addressed. Specifically, the two institutional frames that I will illustrate are Sony's cultural frame and its historical frame. These two institutional frames played a dominant role in shaping the policy conversation between Sony and its consumers.

Sony's institutional frames kept it from properly aligning the interest and purpose of the consumers with the PS3. Schön and Rein define institutional frames as “the more generic frame from which institutional actors derive the policy frames they use to structure a wide range of problematic policy situations.”⁹¹ For the authors, what goes into institutional frames are: prevailing systems of beliefs, category schemes, images, routines, and styles of argument and action. It should be noted that institutional frames tend to be complex and hybrid in nature. They do not usually consist in a single, coherent, overarching frame, but in families of related frames.⁹²

Cultural Frame:

Within Sony's institutional frames, one subgroup of related frames is formulated around Sony's culture. This cultural frame encourages an engineering mindset. In an

⁹¹ Ibid.

⁹² Ibid.





interview the current CEO of Sony, Howard Stringer, talked about how Sony's culture celebrates proud innovators who do what they want. It was pointed out in this interview that many in Sony still quote an admonition by one Sony veteran: "If you (an engineer) have the misfortune to be under a clueless boss (management), don't tell him about new ideas -- just execute them."⁹³ This cultural frame puts the technical innovator at the center. The technical innovator can solve all the problems. Management and the other departments just get in the way of finding the best technical solution. This institutional frame narrows down what the PS3 could have been by envisioning the PS3 as only a technical artifact created by innovative engineers.

Two specific examples of Sony's cultural frame at work in the PS3 are the decisions to use Blu-ray and the Cell processor. In both examples, Sony frames the use of superior technology as the only way to address the needs of future consoles. Sony Computer Entertainment America's president, Kaz Hirai, is quoted as saying:

Our decision to include the Blu-ray player ... in all of our PlayStation 3s was the right decision. Look at the massive amounts of data that's required to provide a truly immersive gaming experience in true HD. If you only have a DVD ROM drive, which can only go up to about 9GB or so, you're going to end up with a game that's going to have two or possibly even three discs. And then you're going to have to ask consumers to swap discs out or cache all the game onto the hard drive which I think is an inconvenience -- not to mention the fact that you're going to fill up a 20GB hard drive very quickly with some of these games. So trying to go without a Blu-ray drive in the PlayStation 3 really is a nonstarter.⁹⁴

⁹³ NeoGaf "Caught between two worlds, the Sony chief tightens his management grip. Will it work?," <http://www.neogaf.com/forum/showthread.php?t=144875> (accessed May 1, 2007)

⁹⁴ Cnet "Let the PS3 games begin," http://news.com.com/Let+the+PS3+games+begin+-+page+2/2008-1043_3-6110352-2.html?tag=st.next (accessed May 1, 2007)





The decision to use Blu-ray is framed as being a necessary component for the future success of the PS3. Likewise, Sony's semiconductor chief Kenshi Manabe frames the use of the Cell processor in the same manner. The Cell processor is framed as a vital component in overcoming current limitations in video game consoles, and pushing the technology where it needs to go for the success of the PS3.⁹⁵

Oddly enough, Sony has yet to release a game that utilizes the extra space on the Blu-ray discs or that needs the superior processing power of the Cell processor. Furthermore, Sony's competitors do not seem to be facing any problems in the market place by not having these technologies. Sony's competitor, the Microsoft Xbox 360 console, can display virtually the same graphical detail as the PS3 while utilizing only standard hardware. One of Sony's other competitors, the Nintendo Wii console, utilizes five-year-old technology, but is the bestselling console of the current generation. Yet Sony's cultural frame has locked it in a mindset that only superior technology will lead to success.

Historical Frame:

Another major subgroup within Sony's institutional frames is formed around Sony's history; specifically, it is formulated around Sony's past success in the video game console industry. Prior to the release of PS3, Sony's previous consoles, the Playstation 1 (PS1) and 2 (PS2), were phenomenal successes. Both the PS1 and PS2

⁹⁵ Businessweek "Sony: Shooting from the Chip?" http://www.businessweek.com/technology/content/dec2005/tc20051222_242937.htm (accessed May 1, 2007)





were the dominant consoles of their respective generations, and each console accounted for over 60% of the market share. Currently the PS2 is widely regarded as being the bestselling video game console of all time.

All of Sony's past successes culminated into a historical frame that constricted Sony's mindset on what could be conceived as an acceptable design of the PS3. The Sony Computer Entertainment (SCE) division was in charge of designing the PS3 and, for the most part, the top SCE management has not changed since the creation of the PS1. Everyone in Sony knew of the success of the SCE division, and as such no one felt like they could question them. Even the CEO of Sony had little control over the SCE division. For example, the cost of the PS3 was kept hidden from the CEO until three months prior to its launch.⁹⁶

Sony's historical frame instilled the belief that Sony can do no wrong with the PS3. This frame built in a high level of arrogance in regards to what Sony thought it could accomplish. The historical frame justified the use of the past success of the PS1 and PS2 as evidence that Sony knows what the consumers want and how best to give it to them. David Reeves, the CEO of Sony Computer Entertainment Europe, is quoted as saying:

“Sony has built up a certain brand equity over time since the launch of PlayStation in 1995 and PlayStation 2 (PS2) in 2000 that the first five million people are going to buy the PS3, whatever it is, even it didn't have games.”⁹⁷

⁹⁶ Neogaf “Howard Stringer, Japanese CEO Caught between two worlds, the Sony chief tightens his management grip. Will it work?” <http://www.neogaf.com/forum/showthread.php?t=144875> (accessed May 1, 2007)

⁹⁷ CVG “Sony: Key PS3 launch titles hit in 2007,” <http://www.computerandvideogames.com/article.php?id=140302> (accessed May 1, 2007)





Another example of this belief of assured success can be seen with a quote by Sony Computer Entertainment America's Executive VP, Jack Tretton, where he states:

“We don't expect nor do we need everybody to embrace the [PS3] technology from day one. But I think what we're saying with PS3 is that this is the machine that is going to drive gaming for the next ten years and this is the machine that you need to own and that will be valid and up to snuff from a technology standpoint for the next decade.”⁹⁸

Sony's historical frame justifies their past success as evidence in arguing that they understand what technologies are needed to drive the industry for the next decade. The institutional frames that the PS3 was designed in was one where failure was inconceivable, because there was an unquestioning faith in Sony's past successes. From this vantage point Sony felt confident in using technologies it deemed important; regardless of the end cost to the consumers.

Policy Conversation and the Misalignment of Interests:

Yet the consumer's interest in what the PS3 should be was vastly different than what Sony envisioned. As information about the PS3 leaked out to the consumers, they expressed their concerns about the direction of the PS3. The authors call this discrepancy between the original intentions of PS3 designers and the meanings constructed for the

⁹⁸ GameDaily, “Interview: SCEA's Jack Tretton,” <http://biz.gamedaily.com/industry/feature/?id=13906> (accessed May 1, 2007)





PS3 by the consumers as a “policy conversation.”⁹⁹ It should be noted that this term does not refer to a literal conversation.

For Schön and Rein, a policy conversation “is a metaphor for policy design seen as communicative interaction between designers and those who use or have a stake in the policy object.”¹⁰⁰ A policy object is defined as the object being conversed about. In the context of the AHP model the OPP would be the policy object; so within this chapter the policy object is the PS3. Messages about the policy object are sent out into the larger environment. Other actors, like consumers, in the environment who come into contact with those messages must somehow make sense of them and figure out how to respond to them. The messages about the policy object are not objectively true to the designers’ intent; the other actors construct their own meanings of the messages. They in turn send messages back to the designers by the way in which they construct their own meanings of the messages; this is called “back talk” for the authors. The designers can respond to this back talk, and by doing that a new set of messages about the policy object is sent out. This process of sending out messages and back talk would be interpreted by the AHP model as the mechanism by which the alignment of interests between the focal actor and other actor-networks occurs.

Sony sent out multiple messages regarding their vision for the PS3. Again and again, Sony stated that the PS3 should be viewed not as a video game console but as a home entertainment device. A clear example of this is when during development of the PS3 Ken Kutaragi, president of SCE and known as the father of the PlayStation, went on

⁹⁹ Schön, D. A. and M. Rein (1994). Frame reflection : toward the resolution of intractable policy controversies. New York, BasicBooks.

¹⁰⁰ Ibid.





record as saying: “PS3 is not a game machine. We've never once called it a game machine. With the PS3, our intentions have been to create a machine with supercomputer calculation capabilities for home entertainment.”¹⁰¹ This specific message about the policy object met a great deal of resistance by the consumers and even some members of Sony. This pressured Sony's Chief Technical Officer, Masayuki Chatanai, to publicly state that: “make no mistake--games will be the killer application for the PS3.”¹⁰² These contradicting messages about the policy object created confusion about the purpose of the PS3 for consumers.

Prior to the launch of the PS3, one article actually states that Sony is sending mixed messages about it. Joystiq on November 18th, 2006, asked the question is Sony’s PS3 competing against the Xbox 360 or HD-DVD?¹⁰³ The Xbox 360 is a competing video game console for the PS3 and HD-DVD is a competing disc format for home movies. Blu-ray was the main competitor with the HD-DVD standard for home movies. Sony hoped that by incorporating Blu-ray into the PS3 that it would send out a message to the consumers that the PS3 is a home entertainment system. Yet, as Sony officials have stated previously, Blu-ray should be viewed as a critical component for future video game consoles. Nevertheless, deciding to incorporate Blu-ray into the PS3 has led to higher costs and production delays, and as stated by an author of thestreet.com, Blu-ray

¹⁰¹ Shackneww, “The Kraziness of Ken Kutaragi,” http://www.shacknews.com/extras/kutaragi/070705_kutaragi_01.x (accessed May 1, 2007)

¹⁰² Ibid.

¹⁰³ Joystiq, “Sony not competing with Microsoft, Nintendo,” <http://www.joystiq.com/2006/11/18/sony-not-competing-with-microsoft-nintendo/> (accessed May 1, 2007)





provides “no discernible improvement in game quality.”¹⁰⁴ These mixed messages left the consumer confused. The consumer did not know what to make of the PS3, and was left wondering if the PS3 was a video game console or a home entertainment system. The Joystiq article ends by making its own recommendation. It states: “We suggest they (Sony) pick one main feature, go for the games!, and treat the other as a value add.”¹⁰⁵ Without a clear message from Sony about the purpose of the PS3, consumers defaulted to viewing the PS3 as a video game console.

This is not the first time that Sony has faced this challenge. Sony tried to sell the PS2 as a home entertainment system as well, but ultimately failed. Back in 2000 Sony's Chief Marketing Officer, Andrew House, is quoted as saying: “Our goals are much different from our competition's. We're trying to reach a broader audience. If [the PS2] is just a game console, then we've failed.”¹⁰⁶ Similar to the PS3, Sony incorporated DVD disc drives into the PS2 to send the message that the PS2 is a home entertainment system. Five years after the launch of the PS2, it is seen as nothing more than a video game console; though, granted, a hugely successful video game console.

Given the institutional frames that Sony worked in, the failure of the PS2 as a home entertainment system could not be understood as misinterpreting the consumers' interests. Instead, given Sony's cultural frame, this failure would be seen as technical problem that needs a technological solution. For Sony it must have been clear, the PS3

¹⁰⁴ TheStreet “Sony's PS3: High-Scorer No More,” http://www.thestreet.com/_tscrss/markets/activetraderupdate/10330004.html (accessed May 1, 2007)

¹⁰⁵ Joystiq, “Sony not competing with Microsoft, Nintendo,” <http://www.joystiq.com/2006/11/18/sony-not-competing-with-microsoft-nintendo/> (accessed May 1, 2007)

¹⁰⁶ Joystiq, “The PS2 failed, according to Sony Exec VP” <http://www.joystiq.com/2005/10/16/the-ps2-failed-according-to-sony-exec-vp/> (accessed May 1, 2007)





simply needed more and better technology so that it could be accepted as a home entertainment system. Yet, as Craig Mundie from the Economist stated: “technology firms are pushing a futuristic vision of home entertainment not because consumers are desperate for it but because they themselves are.”¹⁰⁷ It is Sony’s institutional frames and a desire to find a technical solution that kept Sony from properly aligning the interest of the consumers with the PS3.

So, on one hand, you have Sony pushing the PS3 as a home entertainment system, and, on the other hand, you have consumer back talking that they just want a video game console. Sony tries to respond to this back talk by stating how the new technology in the PS3 is needed for the future of video games, but this message gets confused with the original message Sony sent out that the PS3 is a home entertainment system. Schön and Rein would say the messages sent back from consumers, or back talk, violated Sony's taken-for-granted assumptions and tacit “action frame.”¹⁰⁸ Since the back talk goes against Sony's institutional frames, Sony does not know how to respond. For Sony, the benefits of the PS3 are obvious; the PS3 is a cheap home entertainment system. It should be noted that cheap here specifically refers to the final cost to consumers. For example, at the launch of the PS3 an average Blu-ray player sold for about \$1000. The PS3, which can play Blu-ray discs and can play games, sold for \$600. In fact, Sony sold each PS3 at a loss of \$250¹⁰⁹ to itself, just so that it can subsidize the final price of the PS3.¹¹⁰

¹⁰⁷ Craig Mundie, “The digital home' is 'marketing claptrap,” Economist September 3, 2005 print edition

¹⁰⁸ Schön, D. A. and M. Rein (1994). Frame reflection : toward the resolution of intractable policy controversies. New York, BasicBooks.

¹⁰⁹ As the end footnote for this sentence further details, the total cost of the PS3 is estimated around 850 dollars, but Sony was forced to the sell the console at a lose to itself to be able to compete with rival consoles. This is not an uncommon practice in the video game console industry since companies use software sales and licensing as a way of recuperating their profits.





Yet the consumer has repeatedly back talked to Sony stating they don't want a cheap home entertainment system, they want an affordable video game console. Consumers do not view \$600 for a video game console as affordable; especially compared to Nintendo's Wii that sold for \$250. A prime example of this back talk is a widely circulated letter just before the release of the PS3 from an anonymous person to Sony. The anonymous person referred to himself as a PS3 fanboy. Here is a sample of the letter:

...i just cannot live without the playstation 3 see it makes no difference to you (Sony) changing the prices of the ps3 from 500\$ to 900\$ or whatever but sir it does make a lot of difference to us...

...My basic needs of life are food, clothing, shelter, and above all the playstation 3. even if u want to shoot up the price or decrease it by no matter what i request you (I MEAN THE SONY ENTERTAINMENT COMPANY) that can u plz give me a ps3 by about 400\$ or so I promise i wont tell this to anybody u see the problem is that i dont want to lose and stop doing the one last thing i really love in this world that is gaming...¹¹¹

Once someone looks past the grammatical mistakes, the message to Sony is clear. The PS3 is seen as a video game console, and the consumers want it at an affordable price. This same message is echoed in an interview conducted by NPR. NPR interviewed a group of gamers during the first week of the PS3's release, and when asked why the PS3 isn't selling well, one responds was, "It's just the price, the only thing that kills it is the price. Six-hundred, seven-hundred dollars out the door, that's a lot of money. If it was the

¹¹⁰ isuppli, "PlayStation 3 Offers Supercomputer Performance at PC Pricing, iSuppli's Teardown Analysis Reveals," <http://www.isuppli.com/news/default.asp?id=6919> (accessed May 1, 2007)

¹¹¹ Joystiq, "Letter from a PS3 fanboy to Sony," <http://www.joystiq.com/2006/02/18/letter-from-a-ps3-fanboy-to-sony/> (accessed May 1, 2007)





price of the Xbox, I'd get one.”¹¹² Yet it seems Sony goes out of its way to dismiss this message.

There are two legendary examples of Sony responding to this back talk regarding the price of PS3. I say legendary because anyone who has followed the story of the PS3 knows of these infamous two examples. The first is when the president of SCE, Ken Kutaragi, addressed the matter of the high price of the PS3 by stating: “We (Sony) want consumers to think to themselves 'I will work more hours to buy one (PS3)'. We want people to feel that they want it, irrespective of anything else.”¹¹³ He goes on to state that the PS3 should be viewed as a fine dining experience, and as such, people should naturally expect to pay more. So in essence, Sony responded to consumer's back talk by stating they should get a second job, and shut up. To say that this reply was not taken well would be an understatement.

Findings of this Example:

Sony's institutional frames created the expectation that the PS3 would be used as a home entertainment system; in contrast, the consumers mainly just wanted the PS3 for games. Due to Sony's expectations, they loaded the PS3 with cutting edge technologies; all which drove up the cost of the final product. The PS3 was cheap if viewed as a home entertainment system, but extremely expensive if viewed as just a video game console.

¹¹² NPR “Video Game Pioneer Kutaragi Leaves Sony,”
<http://www.npr.org/templates/story/story.php?storyId=9884088> (accessed May 1, 2007)

¹¹³ Shacknews, “The Kraziness of Ken Kutaragi,”
http://www.shacknews.com/extras/kutaragi/070705_kutaragi_01.x (accessed May 1, 2007)





Even though Sony's intentions for the PS3 was to be a home entertainment system, consumers did not want to pay such a great sum for what they perceived as simply a video game console.¹¹⁴

When analyzed with the AHP model the high cost of the PS3 meant consumers would experience it as a radical innovation, and this experience played a major role in the PS3 being ranked lowest in terms of total sales out of all the current generation video game consoles.¹¹⁵ Up until the PS3 none of the major video game consoles cost more than \$300 for a basic unit; the basic PS3 cost \$600 when it was first introduced.¹¹⁶ The high cost for a PS3 meant that the vast majority of consumers had to radically alter their behavior in order to acquire this technology. Given both the alteration to behavior and the hardware changes from its predecessor the Playstation 2, the PS3 would be considered a radical innovation for consumers. Sony's institutional frames forced it to try to define the PS3 as a home entertainment system to the consumers. These frames initially kept Sony from properly aligning the PS3 to the consumer's interest to have an affordable video game console that focused on game play.¹¹⁷

I used this chapter to demonstrate how one actant, Sony's institutional frames, affected the alignment of interest between the focal actor, Sony, and another actor-network, consumers. All the critical evidence that I used in this chapter came prior to the

¹¹⁴ Said in another way, consumers saw it as radical to pay such a great sum for what they perceived as simply a video game console.

¹¹⁵ Gamesindustry.biz, "PlayStation 3 hardware sales plummet 82 per cent," http://www.gamesindustry.biz/content_page.php?aid=23977 (accessed May 1, 2007)

¹¹⁶ There is a long history of video game consoles that cost more than \$300, like the Jaguar, but none of these high costing systems ever became successful.

¹¹⁷ The Nintendo did just that by creating the Wii. The Wii is an affordable video game console that focuses on game-play, and it is currently dominating the sales charts.





release of the PS3. I used prior evidence because I wish to show that the AHP model can be used predict future trends in technology adoption. Analyzing this prior evidence with the AHP model, I would have made the educated guess that Sony's PS3 would meet a great deal of resistance in terms of sales from the launch of the product. Consumers from the very launch of the PS3 will see it as a radical innovation, and as such will be slow to adopt it. Until Sony addresses the actant of its institutional frames it will experience a great deal of trouble in having its technology be adopted by consumers.¹¹⁸

¹¹⁸ Sony's does just this and restructures the SCE division; even going as far as forcing Ken Kutaragi to retire. After the restructuring Sony eventually cuts the cost of a basic PS3 to \$400, and is now seeing an up swing in terms of sales.





CHAPTER 5

Using Econometrics to Test the AHP Model

To test the AHP model and my findings in the previous chapter I will use the stock market as a surrogate measure for the American video game consumers, which I will just call consumers for the rest of this chapter. In part a company's stocks are valued based in response to perceived future growth, and therefore stocks fluctuate on information that indicates the direction the market feels the company is growing in.¹¹⁹ If the market receives information that leads it to believe that a company's new product is going to be successful, in terms of being adopted by consumers, then the market will push the company's stock higher. Given this functionality of the stock market I believe the stock market will be an adequate surrogate measure for consumers' interpretation of the kind of innovation a technology is.

By using the stock market I will be able to gauge the consumers reaction to information about the technology before the technology is released, and as such I will be able to test the AHP's prediction in the last chapter. I will gauge the consumers' reaction by performing an event study from econometrics. An event study is applicable to the AHP model because it is a method of analyzing the reaction of information. Companies send out information to the market in the form of official press releases, and the markets interpret and react to this information. An event study allows the researcher to gauge the impact of the information. In essence an event study will let me gauge the impact of

¹¹⁹ In reality there are many things that can affect a stock's price, but logically it makes sense that if the stock market received information that led it to believe that a future product of a company is going to be successful, then the stock market would push up the value of that company's stock.





information about a technology on consumers, through the surrogate measure of the stock market, before the technology is launched.

In addition an event study fits well within the philosophy of the AHP model. Both companies and the stock market can be seen as actor-networks, and in addition companies would also play the role of focal actors. In playing the role of the focal actor, companies can be seen as trying to align the stock market to the OPP, or their technology, through the mechanism of dispersing official press releases. The stock market either aligns itself with the focal actor by increasing the company's stock price, or the stock market can misalign itself by lowering the stock price. So within this terminology, the event study will test how well Sony is able to align the PS3 with consumers through the surrogate measure of the stock market.

I will not only perform an event study on the Sony's Playstation 3 (PS3), but its two main competitors, the Nintendo's Wii, and Microsoft's Xbox 360 (360). By performing an event study on all three consoles in this new generation I will be able to put my findings regarding the PS3 in better context. Even though my example in the last chapter only pertained to the PS3 I still did make claims about the other consoles. One indirect claim being that the Wii would do well in terms of sales because Nintendo properly aligned the interest of the customers to have an affordable and game-play oriented Wii. By performing a complete event study on all the consoles I will be able to test all the claims my model has made, and test to see how consumers interpret each console.

The Kinds of Innovation:





For the sake of brevity I will be using Rebecca Henderson and Kim Clark's system of classifying technological innovations for the 360 and the Wii. The AHP model utilizes Henderson and Clark's system, but it should be noted that the AHP model adds a great deal more context in determining the kind of innovation a technology is for a given group. The only reason I am not using the AHP model to analyze the other consoles is because of the limitations of a Master's thesis. I do not feel I have the time to do a properly supported analysis of the Wii and 360 using the AHP model like I did with the PS3 in the last chapter. Henderson and Clark's system, however, should be adequate in providing a rough idea of the kind of innovation each console is for consumers.¹²⁰

The central question asked in Henderson and Clark's system is whether the innovation is overturning existing knowledge of core concepts/components and/or linkages between them.¹²¹ Different groups can answer this question differently regarding the same technological artifact. For example the supplier might answer this question differently than the innovating entity. The vantage point I will use in answering this question will be the preexisting American video game console consumers. So linkages refer to the understanding of how to operate the console, and core components refers to capacities of the console.

The Wii does not overturn existing core components. It is almost identical in terms of technical specifications to its predecessor the Nintendo Gamecube. It does not increase the capabilities of what consoles can do. What the Wii does is change the

¹²⁰ In addition by using Henderson and Clark's system, I will be able to compare its analysis and a quick AHP analysis in my conclusion, and in doing so further showing the strength of my AHP model.

¹²¹ Allan Afuah and Nik Bahram, "The hypercube of innovation" *Research Policy* 24, (1995): 52





linkages between the customer and the console. The Wii implemented a new way for customers to interact with their consoles. It overturned the existing understanding of how to operate consoles that customers held or, in other words, it overturned the linkages between customers and consoles. Henderson and Clark classify this kind of innovation as an architectural innovation.

The 360, on the other hand, does not overturn neither the core components nor the linkages; it simply reinforces them. Preexisting customers do not need to orient themselves differently to be able to use the 360 compared to its predecessor the the Xbox 180. The 360 does not push the capabilities of consoles to new territories either. In terms of capacities, the 360 was the next expected stage for preexisting customers. The 360 is an incremental innovation.

I will reference my analysis done with the AHP model in chapter four in determining the kind of innovation the PS3 is. I conclude in chapter four the PS3 would be a radical innovation for consumers, and as such, would be slow in its adoption. I summarize that the PS3 is a radical innovation because it overturns both the existing linkages and existing core components. However unlike Henderson and Clark's system, the AHP would include altering how to acquire a technology as overturning existing linkages between the customers and technology. The dramatic price increase from the PS2 to the PS3 warrants the PS3 to be labeled as a radical innovation for consumers.

Each company had a distinct strategy for what kind of console they were going to create. Sony, judging from its past success with the Playstation PS2¹²², decided to invest an immense amount of resources to push the console technology as far as it could go with

¹²² The PS2 had the biggest market share out of all the other consoles in its generation, and is referred to as one of the most successful video game consoles of all time.





the PS3. Microsoft, wanting to beat the PS3 to the consumer market, decided to quickly put together the next logical step in video game console technology. Nintendo knew that it could not compete with Sony or Microsoft in terms of resources or technological expertise. So Nintendo decided to use the Wii to reinvent the consumer market in terms that it could compete in; namely, game-play and not graphics.



Currently, the Nintendo Wii is the dominant force in the consumer market. The above chart shows the current total sales of each console.¹²³ The Wii has so far out sold the PS3 by a ratio of two to one, and controls over 40% of the market. It should also be noted that the Wii has outsold the 360 even though the latter had a year head start in being on the market. Since Nintendo did not focus on pushing the technological capabilities of the Wii, it was able to stay under budget and presently enjoys healthy profits from console sales. Sony, on the other hand, went over budget in trying to push the technological capabilities of the PS3 and still finds itself in third place. The cartoon below depicts the sentiment of the general public regarding Sony's efforts and how they seem to have gone to waste.

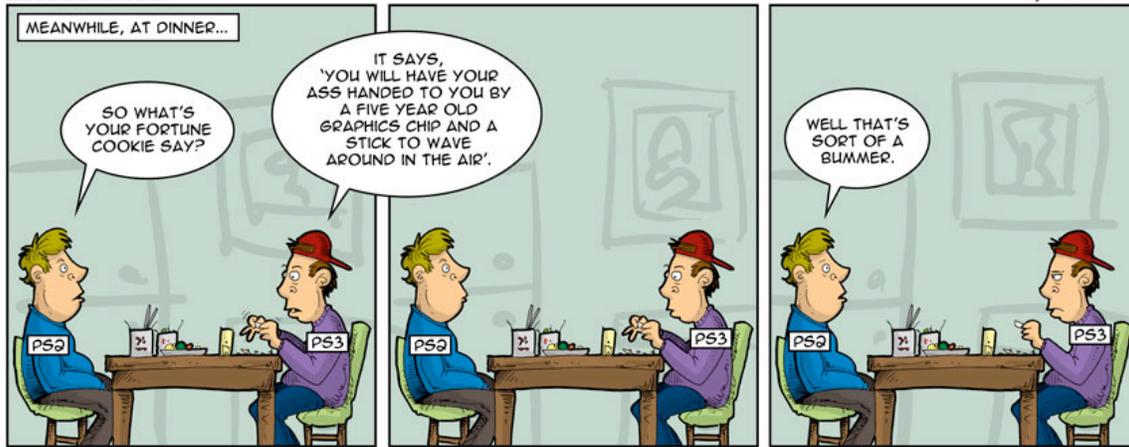
¹²³ Chart comes from the site: <http://vgchartz.com/> that tracks worldwide console sales.





EXTRALIFE

by Scott Johnson



There are many historical, political, economic, cultural, reasons for the current state of affairs, and I have used the AHP model to analyze some of these factors. What I will test is how well each company aligned the consumers with their technology before the technology was launched. Each console has been labeled as a different technological innovation, and I will test to see if consumers, through the surrogate measure of the stock market, align easier with certain of these technologies compared to others. Alignment will be measured by fluctuations in the stock price of each company as information was revealed about their respected console. To measure these fluctuations I will conduct an event study.

Event Study Method:

The purpose of an event study is to see if a particular event influences some





outcome.¹²⁴ In general this method is used to study how an event influences a firm's stock price. The event study is based on the assumptions that capital markets are efficient to evaluate the impact of new information on expected future profits of a firm, and the expected future profits of a firm is directly related to its stock price.¹²⁵ A quick example of an event study would be to examine the effects of announcing layoffs on a firm's stock price. The event study would show if the event of announcing layoffs is in general correlated to a raise/decline in stock price of the announcing firm.

Jeffrey Wooldridge, in his book *Introductory Econometrics*, states a simple version of an equation used for event studies is:¹²⁶

$$R_t^f = B_0 + B_1R_t^m + B_2d_t + u_t$$

Wooldridge defines R_t^f as the stock return for firm f during period t , and R_t^m is defined as the market return computed from a broad stock market index. The variable R_t^m is important because it controls for the movements of the broader market. When the event itself occurred is captured by the dummy variable d_t . The u_t variable is the error term.¹²⁷

In terms of the above example d_t would denote the time frame in which the layoff announcements become publicly known. An event study can incorporate many other

¹²⁴ Wooldridge, J. M. (2006). Introductory econometrics : a modern approach. Mason, OH, Thomson/South-Western.

¹²⁵ Susmita Dasgupta, B. L., and Nlandu Mamingi (1998). "Capital Market Responses to Environmental Performance in Developing Countries." Social Science Research Network Working Paper Series: 36.

¹²⁶ Wooldridge, J. M. (2006). Introductory econometrics : a modern approach. Mason, OH, Thomson/South-Western.

¹²⁷ Ibid.





variables, but the ones listed above are fundamental variables need for an event study.

A successful event study involves five steps. First the events must be clearly identified, and the time frame or event window must be defined. Then, the researcher selects the sample set of firms that will be included in the study. Then the “normal” stock return during the event window needs to be predicted in absence of the event. Following this, an abnormal return can be estimated by taking the difference from the actual and predicted returns. Finally, the abnormal return needs to be tested to see if it is statistically different from zero.¹²⁸

Mathematically, determining the abnormal return is represented by this equation:¹²⁹

$$AR_{iT} = R_{iT} - E(R_{iT} | X_T)$$

For this equation AR defines the abnormal return, R the actual return of the stock, and $E(R | X)$ the estimated normal return. The iT denotes that these variables are for firm i over time period T . Specifically X_T represents the conditioning information needed to estimate the normal return.

There are several different ways of estimating the normal return. The two most

¹²⁸ Susmita Dasgupta, B. L., and Nlandu Mamingi (1998). "Capital Market Responses to Environmental Performance in Developing Countries." Social Science Research Network Working Paper Series: 36.

¹²⁹ MacKinlay, A. C. (1997). "Event Studies in Economics and Finance." Journal of Economic Literature **35**(1): 13-39.





common models used are the constant mean return model and the market model.¹³⁰ In the constant mean return model a constant nominal return for the stock is estimated over the period of the event window. One generic way of estimating a constant nominal return is obtaining the return given on U.S. Treasury Bill for that time period.¹³¹ The market model, on the other hand, relates the normal return of a given stock to the return of a market portfolio. This model assumes a linear relationship between the return of the stock and the return of the market portfolio. The above equation supplied by Wooldridge is an example of a market model.

Regardless of how the normal return is estimated, it is critical because it puts the event study into context. Without estimating the normal return the results of an event study would be meaningless.¹³² The normal return makes it possible to distinguish the effect of the event from the effect of other stock market fluctuations that may have occurred during the same event window. For example say the market dropped by 3% during the event window. A study done without estimating the normal return will falsely show a negative correlation between the event and the return of a stock. Yet estimating a normal return will account for such fluctuations. The 3% drop will be factored into the normal return. Any deviation from the 3% would be accounted for as the abnormal return that is correlated with the event.

¹³⁰ Mackinlay article describes a range of different models that on one side rely more on statistical methods and the other side more on economic theory. The constant mean return and market model are basic models that set in the middle of the range of models Mackinlay described.

¹³¹ MacKinlay, A. C. (1997). "Event Studies in Economics and Finance." Journal of Economic Literature 35(1): 13-39.

¹³² In Mackinlay's article several different ways of estimating the normal return are described. The reason that scholars keep trying to figure out different ways to estimate the normal return is because it is key to making sense out of the findings of an event study.





Given how critical it is to estimate the normal return I will be using the market model for this study.¹³³ Craig MacKinlay states in his 1997 article *Event Studies in Economics and Finance* that the market model represents an improvement over the constant mean return model. For MacKinlay, the market model removes the portion of the return that is related to the variation in the market return from the abnormal return. Therefore the market model has an increased ability to detect event factors. MacKinlay does point out that it is important to select a market index that is closely related to the stocks being studied. If the market index is not related to the stocks then it will just introduce bias into the event study. For example, an oil and gas index would do little to capture the fluctuations in a firm that produces software.¹³⁴ It is up to the researcher to make sure that the companies selected, events under study and index chosen, are all relevant to each other both statistically and in the real world.

For my events I will use the official press releases regarding each console. The event itself consists of the day of the press release, two days prior and two days after. I will look at two days prior to account for news leaks and two days after to account for any lags in the news circulation. The two days prior, the day of the press release and two days after will account for what I will call my five-day event window for each press release. For each console I have collected all the press releases starting from the first one that primarily focuses on some major aspect of the console and ending with the one that announces the launch of the console.

¹³³ What I used as my guide for conducting a traditional event study in STATA was Princeton University library's Data and Statistical Services. Their website is: http://dss.princeton.edu/online_help/analysis/analysis.htm (accessed 5/5/2007)

¹³⁴ MacKinlay, A. C. (1997). "Event Studies in Economics and Finance." *Journal of Economic Literature* 35(1): 13-39.





There are 14 relevant press releases for Sony's PS3. The dates for these press releases range from May 2004 to November 2006. Sony has the widest date range reflecting the fact that it invested the most resources out of the three companies. There are 10 relevant press releases for Microsoft's 360 with dates ranging from March 2005 to November 2005. Microsoft has the shortest date range out of the three companies. This is due to the fact that Microsoft wanted to enter the consumer market first; so they launched the 360 a year earlier than the other companies. There are 14 relevant press releases for Nintendo's Wii with dates ranging from March 2005 to November 2006. I acquired these press releases from each company's main website.

To clarify, I define relevant as any press release where, at the time of its release, its main focus is the console or any major aspect of the console. The reason for this clarification is that there are three older Sony press releases that I intentionally left out of my analysis. These three press releases were about the Cell processor that later would be revealed as the CPU for the PS3. These three releases, however, did not mention the PS3 in any way. Since I am only looking at relevant press releases about the PS3 I chose to leave these three press releases out of my analysis. Though it should be noted here that it was speculated as far back as 2001 that the Cell processor would be the used in the PS3.

This reveals a shortcoming in implementing this kind of event study. There were great deals of rumors circulating for each console. Some of them turned out true, others false. The problem of using rumors as events is that it is very hard to know who has access to them and when rumors first start. For example, the first website that speculated on the Blu-Ray being incorporated in the PS3 was a technical blog in Japan with a small following in 2001. Yet this is just one-way for rumors to spread: you also have forums,





message boards, word of mouth, and a number of other ways. It is a project in of itself to determine when the rumor first started and who had access to it. To side step all of these issues I have decided just to look at press releases. For the most part, press releases put a stop to the speculations and confirm to the stock market the direction the company is going to take. This event study is only looking at the information the companies officially release and the stock market's reaction to this official information.

In accordance with traditional event studies, I will be using stock prices as my main variable. The company's stock symbols are for: Nintendo (NTDOY), Microsoft (MSFT) and Sony (SNE). I collected stock prices for a 120 days prior to the event window of each press release and for each five days in the event window. This 120 day period is referred to as the estimation window. The stock prices during the estimation window will be used to calculate the expected "normal" return of the stock price in absence of the event; the equation for this is $price = B_0 + B_1 market_return + U$.¹³⁵

s

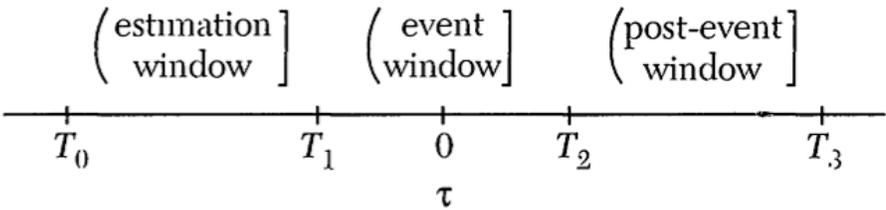


Figure 1. Time line for an event study.

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¹³⁵ The variables are listed out in more detail on the last page nine.





For better understanding I have included above MacKinlay's illustration of the timing sequence in an event study.¹³⁶ For my event study T_0 to T_1 is 120 days, and T_1 to T_2 is 5 days.

I also collected the value-weighted return of the exchange that each stock lists on for the same duration. Microsoft is listed on NASDAQ and the leading Exchange Trade Fund (ETF) that follows this exchange is the NASDAQ 100 Trust Shares (QQQQ). Both Sony and Nintendo are listed on the Tokyo Stock Exchange (TOPIX). Unfortunately, I could not obtain returns for this exchange. Instead I used the ETF of iShares:S&P/TOPIX 150 (ITF) which is the only ETF that follows the TOPIX that I had access too. A point of caution is that the ITF only follows 70% of the TOPIX. So the ITF might not accurately capture every price fluctuation of the TOPIX.

To calculate the expected "normal" stock price, I will use the traditional event study method of regressing the company's stock price on the value-weighted return of the exchange the stock is listed on for each estimation window. The full list of estimation window regressions can be found in Appendix I.¹³⁷ The alphas and betas of these regressions will be saved and used to predict the expected "normal" stock prices in the event window. From there I can get a T-statistic¹³⁸ to see if whether the difference between the actual and expected "normal" stock price during the event window is statistically different from zero.

¹³⁶ MacKinlay, A. C. (1997). "Event Studies in Economics and Finance." Journal of Economic Literature 35(1): 13-39.

¹³⁷ It should be noted that the R squared on some of the regressions for Nintendo and Sony are very low. The reason for this could be because I am using the returns from ITF instead of the real TOPIX

¹³⁸ A T-statistic is a rule used for testing hypotheses where each sample outcome produces a numerical value.





This event study should be able to indirectly take into account other instances related to each console and their companies that are not found in the press releases I have collected. For example during the time frame of this event study: Sony faced the recall of its laptop batteries, Microsoft was facing difficulties with the release of its Vista operating system, Nintendo saw the success of its portable hand held system the DS, to name a few instances. These instances create trends of sell offs or run-ups in stock prices. The estimation window being 120 days long should allow for the expected “normal” stock price to be able to adjust to these trends. The estimation window is close enough to the event so that it should be able to capture any immediate trends in the stock price caused by other instances. What this event study cannot take into account is if a major company incident took place during the same time as a one of press releases I am looking at. From the best of my understanding, this should not pose a problem to this study.¹³⁹

In one way this project is not like a traditional event study. In a traditional event study a one time major phenomenon is analyzed. In this project, however, information that is routinely distributed in the form of press releases is analyzed. In a traditional event study the estimation window is assumed to be devoid of the phenomenon being analyzed. In this project, since official press releases are the phenomenon, it is impossible to find an estimation window devoid of such a phenomenon. For instances, many of the press releases I am analyzing occur during an estimation window of another press release I am analyzing. Nevertheless, this should not be a major hindrance to this project. Since the 120 day estimation window is set up to account for current trends in

¹³⁹ In the future dummy variables could be used to better address this issue. Dummy variables can be created to account for different kinds of information related to each stock.





the stock price, the other press releases would be captured by the expected normal return as simply contributing to the current trend of the stock price.

Table 1: Summary Statistics for Each Variable:

Variable	Observations	Mean	Std. Dev.	Min	Max
<i>date</i>	26694	16675.88	322.2901	15987	17261
<i>company_id</i>	26694	N/A	N/A	N/A	N/A
<i>price</i>	26694	29.64401	10.74053	12.64	52.98
<i>market_return</i>	26694	90.37055	30.06764	31.93	134.37
<i>set</i>	26694	7.105904	3.912425	1	14
<i>id</i>	26694	21.58212	10.80014	1	38
<i>dif</i>	26694	-55.51779	272.0511	-784	731
<i>event_window</i>	26694	.0071177	.0840673	0	1
<i>estimation_window</i>	26694	.1437776	.3508707	0	1
<i>predicted_return</i>	190	28.59399	12.07232	13.20514	58.50828
<i>abnormal_return</i>	190	-.4807825	2.941166	-9.037903	5.726761
<i>cumulative_abnormal_return</i>	26694	-3.890206	15.13188	-38.03446	25.69958
<i>ar_sd</i>	26694	.4202691	.2955418	.079975	1.147642
<i>cumulative_abnormal_daily</i>	26694	-.7780412	3.026377	-7.606892	5.139916
<i>percentage_change</i>	38	-.0036009	.1003667	-.2246572	.2076067
<i>test</i>	26694	-1.979723	7.950262	-18.253	16.71976

The variables used in this study are listed above. *Date* is simply the date.

Company_id is used to distinguish the different companies from one another. *Price* is the





closing stock price adjusted for dividends and split on *date* for *company_id*.

Market_return is the closing price for the exchange *company_id* lists on for *date*. *Set* keeps track of the number of events for each company. *Id* is used to order the total number of events for all companies. *Dif* counts the number of days either before and after the event date; so if *dif* equals zero that means it is the event date. *Event_window* is a dummy variable where a 1 counts as an event day and 0 any other day.

Estimation_window is another dummy variable where a 1 counts as an estimation day and 0 any other day. *Predicted_return* uses the alphas and betas from the earlier regressions with *price* on *market_return* when *estimation_window* equals one, and predicts the expected “normal” stock price if *event_window* equals one.

Abnormal_return equals the *price* minus the *predicted_return* if *event_window* equals one; its equation is $abnormal_return = price - predicted_return$ if $event_window = 1$.

Cumulative_abnormal_return is the sum of all *abnormal_returns* within a *set*. *Ar_sd* is the standard deviation¹⁴⁰ of *abnormal_return*. *Cumulative_abnormal_daily* is equaled to *cumulative_abnormal_return* divided by the number of event dates, which is five, to get the average abnormal return over the event for each *set*; its equation is

$cumulative_abnormal_daily = cumulative_abnormal_return / 5$. *Percentage_change* is the *cumulative_abnormal_daily* variable divided by the *price* on the event day; its equation is $percentage_change = cumulative_abnormal_daily / price$ if $dif = 0$. *Percentage_change* captures the average abnormal percentage change in the stock price due to the event.¹⁴¹

¹⁴⁰ Standard Deviation is a come measure of spread in the sampling distribution of a variable.

¹⁴¹ For the proposes of this project I am only interested in the general magnitude and direction of the change in the stock price. That is why I am looking at the average change in the stock price for each day in the event. I could just as easily calculated the cumulative abnormal change for each event, but it is easier to compare the percentage change between stocks than cumulative abnormal change.





Test can be interpreted as a T-statistic. *Test* equals one over the number of event days, times *cumulative_abnormal_return* over *ar_sd*; its equation is $test = (1/5) * (cumulative_abnormal_return/ar_sd)$. The variables *test* and *percentage_change* ultimately give us results we are seeking.

Results:

Below are the results of the event studies. If the absolute value of *test* is greater than 1.96, then the average abnormal return for the stock is significantly different from zero at the 5% significance level. The value of 1.96 comes from the standard normal distribution with a mean of 0 and a standard deviation of 1. *Percentage_change* demonstrates the economic significance of the event by showing how much the company's stock price was impacted by the event.

Table 2: Summary of Events:

Id	Company	Date	Percentage _change	Test	Title of press release
1	MSFT	03/09/05	-.0257	-7.2533	Microsoft Reveals First Details of Next-Generation Xbox
2	MSFT	05/12/05	.0080	1.4500	Xbox 360 Ushers in the Future of Games and Entertainment
3	MSFT	05/18/05	.0090	1.6829	Premier Titles From Microsoft Game Studios Showcase Awesome Power of Xbox 360
4	MSFT	07/25/05	-.0096	-.6960	Top Japanese Publishers Announce Commitment to





					Xbox 360
5	MSFT	08/17/05	. 0353	14.5833	Microsoft Announces Xbox 360 Price for Europe and North America: Starts at \$299.99
6	MSFT	09/08/05	. 0094	.9785	Xbox Live Offers New Levels, Features and Premium Retail Packs to Supercharge Online Gaming Experiences on Xbox 360
7	MSFT	10/04/05	-. 0443	-3.5994	Xbox 360 Launch Lineup Announced
8	MSFT	10/14/05	-. 0450	-12.2344	Software Update for Windows XP Media Center Edition 2005 Enables High-Fidelity Access to PC Digital Entertainment via Xbox 360
9	MSFT	10/19/05	-. 0414	-8.1535	Microsoft Announces Company's First Cross-Platform Gaming Controller
10	MSFT	11/14/05	. 0089	. 8966	Microsoft Announces Xbox 360 Day One Launch Lineup — Strongest Launch in the History of Video Game Consoles
11	NTDOY	03/10/05	-. 0535	-5.4464	Nintendo President Outlines Bold Vision To Attract New Audiences To Video Games
12	NTDOY	04/19/05	-. 0601	-4.9723	Broadcom Announces Partnership with Nintendo to Enable Next Generation Wireless Gaming Consoles
13	NTDOY	05/17/05	-. 0490	-3.8285	Breaking News from Nintendo's E3 2005 Press Conference
14	NTDOY	09/16/05	. 0485	2.9267	Hands on with the Revolution





					Controller
15	NTDOY	10/05/05	. 0452	1.8640	Nintendo Creates An Easy, Accessible Video Game Network - And It's Free
16	NTDOY	11/16/05	-. 0446	-7.5308	Nintendo Announces Play Control System For Next Hardware
17	NTDOY	03/23/06	. 0316	2.5740	Nintendo President Challenges Developers To Create Bold New Games
18	NTDOY	05/09/06	. 0012	. 0322	Nintendo Introduces the Next Leap in Video Games
19	NTDOY	05/25/06	. 1520	4.9100	Nintendo Announces Wii Information, Worldwide Shipments: The company plans to ship 6 million systems
20	NTDOY	06/01/06	. 1649	14.3672	Nintendo Rakes in the Accolades for Its Wii Console and Games
21	NTDOY	06/06/06	. 1795	6.2770	The New York Times Weighs in on Wii and Nintendo DS
22	NTDOY	08/25/06	. 1734	8.8092	Nintendo Announces Two New Wii Titles at the Leipzig Games Convention
23	NTDOY	09/14/06	. 1069	4.4530	Nintendo's Incomparable Wii Console Launches Nov. 19; MSRP \$249.99
24	NTDOY	11/16/06	. 1562	6.8431	Nintendo's Wii: A Gateway To New Experiences
25	SNE	05/10/04	-. 0333	-2.0878	SONY, SCEI AND IBM TO DEVELOP DIGITAL CONTENT CREATION ENVIRONMENT BASED ON CELL PROCESSOR
26	SNE	09/21/04	-. 0235	-4.3194	SONY COMPUTER





					ENTERTAINMENT INC ADOPTS BLU-RAY DISC ROM FOR NEXT GENERATION PLAYSTATION®
27	SNE	11/29/04	-. 0157	-3.6046	IBM, Sony, Sony Computer Entertainment Inc. and Toshiba Unveil Cell Processor
28	SNE	12/07/04	-. 0046	-. 4945	Sony and nVidia Announce joint GPU development
29	SNE	05/16/05	. 0219	2.9516	SONY COMPUTER ENTERTAINMENT INC. TO LAUNCH ITS NEXT GENERATION COMPUTER ENTERTAINMENT SYSTEM, PLAYSTATION 3 IN SPRING 2006
30	SNE	07/21/05	-. 0473	-2.3370	SONY COMPUTER ENTERTAINMENT TO ACQUIRE SN SYSTEMS ProDG To Become Part of PS3 Development Kit
31	SNE	09/27/05	-. 0305	-5.2101	SONY COMPUTER ENTERTAINMENT TO START PROVIDING PRODG TOOLS FOR PLAYSTATION®3 GAME CONTENT DEVELOPMENT
32	SNE	04/17/06	-. 0355	-3.2980	PLAYSTATION®3 LAUNCHES WORLDWIDE IN EARLY NOVEMBER 2006
33	SNE	04/21/06	. 0089	.4817	SONY COMPUTER ENTERTAINMENT AMERICA ANNOUNCES WIDESPREAD PRESENCE AT THE 2006 GAME





					DEVELOPERS CONFERENCE
34	SNE	05/08/06	-. 0788	-8.1291	SCE ANNOUNCES NEW CONTROLLER FOR PLAYSTATION®3
35	SNE	09/22/06	-. 0527	-9.5834	PLAYSTATION®3 HDD 20GB EQUIPPED WITH HDMI AS STANDARD
36	SNE	10/03/06	-. 1323	-4.4300	ACCESSORIES FOR PLAYSTATION®3 BECOME AVAILABLE
37	SNE	10/19/06	-. 1076	-15.0401	SONY COMPUTER ENTERTAINMENT AMERICA ANNOUNCES EXTENSIVE LINE UP OF GAME TITLES FOR PLAYSTATION®3
38	SNE	11/17/06	-. 0472	-4.6671	PLAYSTATION®3 LAUNCHES NEXT GENERATION OF ENTERTAINMENT IN NORTH AMERICA

Each console has one specific press release that demarcates it as its respective kind of innovation for its preexisting customers. The press release of the 360 and PS3 revealed for the first time detailed technical specifications of each console, and the Wii press release detailed the new way in which users would interact with the console; I included each of these press releases in Appendix VI. They are: for the 360 on 5/12/2005 the press release “Xbox 360 Ushers in the Future of Games”, for the Wii on 9/16/2005 the press release “Hands on with the Revolution Controller”, and for the PS3 on 5/16/2005 the press release “Sony Computer Entertainment INC. to Launch its Next





Generation Computer Entertainment system, Playstation 3 in Spring 2006.” The radical innovation, the PS3, saw the biggest economic gain of a 2% increase in stock prices and was statistically significant with the *t*est being 2.95. The architectural innovation, the Wii, had a slight gain in stock prices at .05% increase; this was statistically significant with the *t*est being 2.93. The incremental innovation, the 360, saw virtually no change in its stock price. For the 360 the *percentage_change* was not economical significant at -.008% and the *t*est was not statistically significant at 1.45.

It seems in this case, when the stock market just takes into account the kinds of innovations a technology is it was not able to predict the success of the architectural innovation over the radical and the incremental innovations. It could be within this case that the PS3 press release was interpreted by the stock market as the PS3 being a modular innovation. Since the final price of the PS3 to the consumers was not revealed in the press release, the market would only be taking into account the PS3’s technical capacities. If this was the case, the findings would make more sense since modular innovations hold the most promise of pushing the consumer market into new arenas. Given the Wii’s slight economic gain, it seems like the stock market does not know what to make out of architectural innovations. This also makes sense since architectural innovations by their very nature reinvent consumer markets.

Yet the stock market seems quick in being able to factor in other information about each console. Listed below are the results of three regressions. Each regression looks at the aggregate *cumulative_abnormal_return* for all press releases regarding their





respected consoles.¹⁴²

Table 3: Cumulative Regressions for Each Console:

Sony's PS3

Linear regression
 Number of obs = 14

	Coef.	Robust Std. Err.	t	P > t	[95% Conf. Interval]
cumulative~n					
_cons	-8.312885	2.347745	-3.54	0.004	-13.38488 -3.240891

Nintendo's Wii

Linear regression
 Number of obs = 14

	Coef.	Robust Std. Err.	t	P > t	[95% Conf. Interval]
cumulative~n					
_cons	7.33179	2.665614	2.75	0.017	1.573082 13.0905

Microsoft's 360

Linear regression
 Number of obs = 10

	Coef.	Robust Std. Err.	t	P > t	[95% Conf. Interval]
cumulative~n					
_cons	-1.11454	1.109294	-1.00	0.341	-3.623937 1.394858

Looking at Sony's PS3 regression, it appears the effects of all the press releases are correlated with a devaluation of Sony's stock by \$8. This effect is both economically significant and given its P-value¹⁴³, statistically significant. Nintendo's Wii regression, on the other hand, shows that all its press releases are correlated with Nintendo's stock gaining \$7 in value. This effect is also both economical significant and given its P-value, statistically significant at the 5% level. Microsoft's 360 regression ultimately shows that

¹⁴² As with all traditional event studies, the robust standard errors were used to account for heteroskedasticity in *cumulative_abnormal_return* due to the correlation of the *abnormal_returns*.

¹⁴³ P-value is defined as the smallest significance level at which the null hypotheses can be rejected. Equivalently, the largest significance level at which the null hypotheses cannot be rejected.





its press release aggregate are only slightly economically significant with a \$1 devaluation, but the regression is not statistically significant with its high P-value.

To put these findings into context I included three charts in appendix IV. Each chart tracks the stock movement of each company during the time period of this study.¹⁴⁴ As these charts show both Microsoft's and Sony's raw stock data does not reflect the findings of this study. During the period of this study Sony's stock ends where it started at around \$40, and Microsoft's stock was up from around \$25 to \$28. Nintendo's stock went from around \$14 to \$30, but what the event study still shows is about how much of the Nintendo's stock increase is correlated to information about the Wii.

Essentially the regressions done by the event study on the aggregate press releases for each console would have been able to predict the success of the Wii over the PS3.¹⁴⁵ It must be noted here again, that the last press release stops at the launch of each console, before any sales data could be collected. This makes sense since it is not necessarily the kind of innovation a product is for one group that determines its success, but a broad array of factors. What needs to be further explained is why the Wii being an architectural innovation was quickly adopted, and the 360 being an incremental innovation had no effect on consumers. In my concluding chapter I will make some educated guesses on why the results turned out the way they did for the Wii and 360.

Some of these other factors include the size of the video game library at launch,

¹⁴⁴ Charts come from Yahoo Finance: <http://finance.yahoo.com/>

¹⁴⁵ It also makes sense that Microsoft's regression is not significant. The 360 is ranked 2nd compared to the other consoles, but this seems to be more due to the PS3's immense failure at the time than any success inherent to the 360. The 360 was never able to reach a broader market. Microsoft was really only able to align the interest of preexisting customers to the 360, and as such, it makes sense that the market did not significantly react one way or another to the 360. Like all good incremental innovations, the 360 was merely a good replacement for Microsoft's previous console the Xbox 180.





and the ease/difficulty of creating content for a console. There are two specific Sony press releases that can be used as examples of these other factors at work. Sony's press release on 10/19/2006 listed the video game library that will be available for the PS3 at launch. This event is correlated with Sony's stock devaluing by 10% and this is statistically significant with *t*est being -15.04. Regardless of the spin Sony tried to put in its press release, the stock market could be reacting to the fact that most of the video games in press release are ports from older systems.¹⁴⁶ The PS3 had a very small library of original video games at its launch compared to the other consoles. The stock market apparently factored in that the video game library at the launch of the PS3 would be inadequate, and that this might be a sign of other problems; for example a difficulty in creating content for the PS3.

Sony's press release on 10/03/2006 is correlated with Sony's stock devaluing by 13% and this is statistically significant with *t*est being -4.4. This press release talks about Sony's wireless controller (SIXAXIS), memory card adaptor, and Blu-ray Disc Remote Control; I included a copy of this press release in Appendix VII. There could be several reasons why this seemingly benign press release had such a large impact on the Sony's stock price. The market could be responding to the fact that the user has to buy an extra adaptor to utilize PS2 components. In this way the market could be reacting to the notion that the PS3 is not adequately enrolling the PS2 and its user in-to the PS3 System.

The market could also be reacting to the Blu-ray remote control part of the press release. As I discussed in Chapter 4, Sony's decision to try to sell the PS3 as a home

¹⁴⁶ A game originally created for an older system, but recoded to work on a newer system is called a port. Ported games are usually looked down on because they do not fully utilize the capacities of the newer system.





entertainment system frames the PS3 as a radical innovation for consumers. The market could be interpreting the part about the Blu-ray remote as the deciding signal from Sony that it is trying to sell the PS3 as a home console, and the market could be responding to this information by devaluing Sony's stock.

The market could also be responding to information about the SIXAXIS, and how this controller allows for a change in linkages between the customer and the console. The SIXAXIS would let users move the controller in 3D space to interact with the console, and this new feature is a different way of interacting with the PS3 than previous generations. If the market perceived a change in linkages between the user and the console, and given the already stated changes in hardware of PS3, this press release could be seen as a signal that the PS3 might be a radical innovation by the market.

Ultimately the press release on 10/03/2006 could have in one way or another contributed to the market perceiving the PS3 as a radical innovation, and as such, the market would react to this event by devaluing Sony's stock. The rationale for Sony's 13% devaluation could be any of the three above explanations, or a combination of them.

Biases:

Even given my explanation for the above two press releases for Sony on 10/03/2006, and 10/19/2006 Sony's stock devaluations still might seem rather large. Especially given the relatively mild nature of the press release on 10/03/2006 about accessories for the PS3 might seem particular large at a 13% devaluation. So I will now show step-by-step where I got the 13% devaluation from Sony's press release on





10/03/2006. By showing how this particular event was analyzed I hope to show where there might be bias in my event study.

The first step in analyzing this event was a regression on Sony's stock price on the Exchange Traded Fund, ITF, which is the market index I used, during the period of the estimation window.

$$Sony's Stock Price_{TimeEstimation} = B_0 + B_1 ITF's Price_{TimeEstimation} + U_{TimeEstimation}$$

The estimation window was from September 28, 2006 to April 7, 2006. In Appendix V I have included a chart of Sony's stock price, ITF's price, and a comparison of the two during the estimation window. Next the alphas (B_0) and the betas (B_1) of the first regression are used to estimate the predicted "normal" return during the event period. The difference between the predicted "normal" return and the actual return gets us the abnormal return.

$$Abnormal Return = Sony's Stock Price_{TimeEvent} - (B_0 + B_1 ITF's Price_{TimeEvent})$$

For this event Sony's predicted "normal" stock returns was an average of \$45. Sony's stock price for the period of the event window was an average of \$39 for each day in the event window. The abnormal return is the difference between the predicted "normal" return of \$45 and actual return of \$39 dollars. This difference of \$6 is where the 13% devaluation comes from.

Where there might be bias is in the estimation window. During the estimation





window Sony's stock plummeted from a high of \$52 to \$42. The ITF also plummeted from a high of \$130 to a low of \$110, but the ITF near the end of the estimation window started to recover its losses. Sony, on the other hand, did not recover from its loss, and as such ITF's price and Sony's stock price started to diverge at the end of the estimation window. This divergence is also present during the event window. As I detailed earlier, the exchange trade fund ITF is not a perfect substitute for the TOPIX index, and that the ITF only follows the TOPIX 70% of the time. This event could be an instance where the ITF fails to capture every market fluctuation, and therefore creates bias in the findings of my event study.

Yet the R-squared and R-Bar squared for this regression is .78 and .78 respectfully. The R-squared and R-Bar squared measure the total sample variation in the dependent variable that is explained by the independent variable.¹⁴⁷ The R-squared and R-Bar squared range from 0 to 1, and the higher the number is the more the dependent variable explains the independent variable. The R-squared and R-Bar squared in this case states that the Exchange Trade Fund, ITF, is capturing the majority of the market fluctuations in Sony's stock price. Thus within this one event it does not seem that the ITF is the source of the bias.

The source of the bias for this event might be external factors or information that the model is not picking up. Other factors, not captured by this event study, could cause Sony's stock to over or under perform the market. The divergence during the end of the estimation window for this event is one example of Sony's stock under performing the market. These divergences might create bias that keeps the regression from capturing a

¹⁴⁷ Wooldridge, J. M. (2006). Introductory econometrics : a modern approach. Mason, OH, Thomson/South-Western.





more realistic predicted “normal” return. I might have been able to account for this bias by having a larger estimation window of say a full year. A large estimation window would moderate the effects of such divergence because they would be averaged out over a longer period of time. Unfortunately my stock data did not go back far enough for me to be able to use a larger estimation window than the 120 day estimation window I used.

Overall though I believe the 120 day estimation window and the indexes I used were able to serve my event study well. Sony’s 10/03/2006 press release is the most troubling out of the events I analyzed in terms of bias. Yet no other event I analyzed exhibited all the same warning signs of bias that the 10/03/2006 press release did. The 10/03/2006 can be seen as the worst-case scenario. I am fully aware that bias is a factor; especially given my limited resources in terms of what data I had access to. Nevertheless, I am still confident in the methodology and findings of my event study.

Summary of Findings:

When the stock market is just presented with the kinds of innovation a product is, it seems to be a poor predictor of future success. Yet the more information the market is given the better predictor it becomes in determining the future success of that product. The behavior of the stock market is in line with how the AHP model works. As more actants become revealed for each actor-network involved in a technology’s System the better predictor the AHP becomes. In this case the aggregated events studies showed what the AHP predicted, and that is Sony did not properly align the interests of the consumers to the PS3. The PS3 was interpreted as a radical innovation by consumers,





and as such consumers were hesitant to adopt it. The stock market reflected the sentiments of the consumer, and the aggregated effects of all of Sony's press releases about the PS3 are correlated with an economical and statistically significant devaluation of Sony's stock price.





CHAPTER 6

Conclusion

In conclusion I was able to reject my null hypothesis that societies adopt technological innovations mainly based on their technical specifications. The Playstation 3 (PS3) was slow to be adopted even though it had the superior technical specifications compared to rival video game consoles. My Actor Network Theory model of innovation (AHP model) demonstrated that, other than technical specifications, factors such history and culture could influence a technology's adoption. These other factors contribute to a technology being categorized by organizations as one of four kinds of innovation, and as in the case of the PS3, a technology labeled as a radical innovation will be slow to be adopted. The findings of my AHP model are supported by my event study in that the aggregated press releases, and not the single press release that detailed the technical specifications of the PS3, were needed to properly predict how the PS3 would be adopted. The event study further showed a correlation between a technology being labeled as a radical innovation and society's hesitation to adopt it.

Limitations:

I need to note the tension between using a mainly explanatory theory, Actor-Network Theory (ANT), to try to predict future outcomes. ANT has historically been used to explain why a technology was or wasn't adopted after the fact. Since I have been working on my thesis for over a year now, I have witnessed my initial prediction come





true in this time. I have felt a great deal of satisfaction watching my prediction come true, and I feel a sense of validation towards my model. Yet, in refining my thesis during this time I have used some new evidence that might create the appearance that am explaining rather than predicting. Yet all the key evidence I used to justify my AHP model's prediction comes before any of the three consoles were released. The AHP model is built on the premise that it can be dynamically updated as more information becomes available. As an AHP model is updated overtime it will be able to explain richer stories, and be more accurate in its prediction.¹⁴⁸ This is where the tension in using ANT arises. On some level I do not believe you can predict without explaining, and I believe that in this thesis by mainly using evidence from before the launch of these technologies I was able to explain and at the same time predict.

Some other limitations need to be noted regarding my findings. I am using the stock market as a surrogate measure for how society will react to a new technology. In essence I am using the stock market's ability to assess the future success of a company's product by evaluating information about the product before it is released. The mechanism in how the stock market evaluates a product is black boxed for this thesis. It is only assumed that the stock market interprets technology adopted similar to the AHP model; though in my opinion this is a relatively safe assumption.

I believe that the AHP model can ultimately be simplified to a commonly held assumption regarding technology adoption. The assumption is the easier you make it for more people to use a technology the more quickly it will be adopted. In fact my whole thesis can be seen as an elaboration of this common assumption. In terms of the AHP

¹⁴⁸ If the AHP model is updated well after the faith of a technology is determined than the AHP model can serve as purely an explanatory model.





model the focal actor is trying to make it “easier” for the other actor-networks by aligning their interest to the technology, the OPP. The focal actor can do this by addressing the actants of an actor-network that make the technology a radical innovation for them compared to an incremental innovation. I surmise the stock market would evaluate a technology using this very simple and common assumption.

Further limitations of my thesis are centered on how the event study was conducted. I could not use the optimal stock indexes that would account for most of the market fluctuations because I did not have access to the data of those indexes. The indexes I used restricted my estimation window to 120 day because the replacement indexes do not date back far enough for me to have any bigger of an estimation window. I believe that the 120 day estimation windows are still adequate, but it would have been helpful to have tested larger estimation windows to see if they would have changed my results.

In addition the event study is capturing correlation and not causation. Event studies do not prove if a particular occurrence causes another. Instead event studies only show correlation between occurrences. Each press release in my event study is correlated with a movement of a stock, and cannot be seen as the cause of the stock fluctuating. My event study shows the statistical relevance of the correlations, but it is the AHP model itself that gives meaning to these correlations.

Another shortcoming of my thesis is that I was not able to give the proper meaning to the correlations found in my event study regarding the Nintendo Wii console and Microsoft Xbox 360 (360). Given the natural limitations of a Master’s thesis I did not conduct a proper analysis of the Wii or the 360 with the AHP model, and instead I used





Rebecca Henderson and Kim Clark's system of classifying technological innovations. Henderson and Clark's system was the base of the Hypercube model that I used to construct the AHP model with. Yet, Henderson and Clark's system by itself is simplistic, and fails to account for many intricacies that the AHP model would.

Analysis of the AHP Model:

Using Henderson and Clark's system the Wii was classified as an architectural, and the 360 was an incremental innovation. In each case Henderson and Clark's system only took into account how preexisting customers would label the technology. Given these labels Henderson and Clark's system would predict that the Wii would have a tough time being adopted, and the 360 would easily be adopted. Yet the event study predicted that the Wii would be quickly adopted, and that the 360 would not initially experience any major growth. These consoles would be categorized differently if I used the AHP model to analysis them. The analysis of the PS3 using the AHP model matched the prediction of my event study, and I believe the same would hold true if the Wii and 360 were analyzed with the AHP model.

If the Wii were analyzed with AHP model not just preexisting consumers would be accounted for but first time consumers as well. Henderson and Clark's system is correct in determining that preexisting consumers would label the Wii as an architectural innovation, but for first time consumers the Wii would be labeled as an incremental innovation. The Wii created the user interface to be much more intuitive, and thus greatly enhanced its attractiveness to the first time consumers. First time consumers did





not feel intimidated by the Wii, and using the Wii felt very natural. Preexisting consumers had to reorient themselves to using the Wii, but first time consumers could start playing games on the Wii from the very first moment. Nintendo successfully aligned the interest of the Wii with first time consumers, and since first time consumers greatly outnumber preexisting consumers, the Wii became a huge success. The AHP model would have been able to capture the alignment of first time consumers to the Wii, and therefore the AHP model's prediction would have matched my event studies' prediction.

Likewise, Henderson and Clark's system does not take into account first time consumers either in regards to the 360. Unlike the Wii, the 360 was not designed to attract first time consumers, or in other words, Microsoft did not try to align the interest of first time consumers with the 360. The user interface of the 360 is complex with many buttons and options. Only preexisting consumers would have felt comfortable using the 360. For preexisting consumers Henderson and Clark's system is correct in determining that that the 360 is an incremental innovation, but for first time consumers the 360 would be labeled as a radical innovation. Once again the AHP model would have been able to capture the misalignment of first time consumers to the 360, and therefore the AHP model would predict that the 360 would only be successful within the preexisting consumer base. The prediction of the AHP would be in line with the findings of my event study. If Microsoft was replacing the revenue of one product with another, in this case the revenue of the Xbox 180 with 360, then it makes sense why its stock did not react much to information about the 360. In the end my event study findings would have made sense if the AHP model were utilized to analyze all three consoles.





Future Research:

In the future I would like to do a complete analysis using the AHP model. One option is to use the AHP model on a historical technology, and see if the AHP model's prediction held up in time. To look at historical technologies I will expand my definition of technology to be more robust, and include other forms of technology than the specific kind I examined in this thesis. Analyzing a historical technology with the AHP model will not only give me another chance to utilize my model, but to see if my model still holds with a more robust definition of technology.

In terms of the even study portion of my thesis, I could conduct a larger event study where I analyze dozens of technologies, and see if the findings match my findings here. I would sort technological innovations into the four kinds of innovation I discussed in my thesis, and I would analyze technologies from across industries instead of just focusing on the video game industry. By analyzing such a wide array of industries I will be able to better understand if there is a correlation between market fluctuations and the kind innovations companies produce.

I plan on also exploring the possibility of converting the AHP model into a computer program. One way I could construct a program is converting the qualitative method of the AHP model to a more quantitative method. To convert the AHP model to a more quantitative method I could utilize game theory; more specifically I could utilize Bayesian game theory. Game theory is a mathematical representation of behavior of players in strategic situations, and in a Bayesian game information about the





characteristics of each player is incomplete.¹⁴⁹ In regards to the AHP model, each of the different actor-networks in a technology's System could be interpreted as players in a Bayesian game. I could then represent the players in a technology's System mathematically, and I would be able to write a program that could analyze the likely hold of a technology's adoption.

In addition I could see if there are other theories that I could combine with the AHP model to get richer predictions. One such theory I would look at is the Unified Theory of Acceptance and Use of Technology (UTAUT). The UTAUT is a consolidation of eight models,¹⁵⁰ and is used to examine the usage behavior and user intentions of technology. For UTAUT these four constructs dictate usage behavior and intention: performance expectancy, effort expectancy, social influence, and facilitating conditions. UTAUT's key constructs are mediated by gender, age, experience and voluntariness of use.¹⁵¹ I believe that I would be able to fold UTAUT's key constructs into the AHP model's four kinds of innovation.¹⁵² In terms of what mediates the UTAUT's key constructs, I believe those can be translated into the AHP model as the actants that lead an actor-network to interpret a technology as a specific kind of innovation. In chapter 4 I have already demonstrated that the AHP model could be combined with other models, and if I were able to combine the AHP model with the UTAUT I could further increase

¹⁴⁹ Heap, S. H. and Y. Varoufakis (2004). Game theory, second edition : a critical text. London, Routledge.

¹⁵⁰ The eight models are: theory of reasoned action, technology acceptance model, motivational model, theory of planned behavior, a combined theory of planned behavior / technology acceptance model, model of personal computer utilization, innovation diffusion theory, and social cognitive theory.

¹⁵¹ Venkatesh, M. G. M., G. B. Davis, and F. D. Davis (2003). "User acceptance of information technology: Toward a unified view." MIS Quarterly **27**: 425-478.

¹⁵² The reason I believe this is possible is because at its heart the four kinds of innovation analyzes how user behave with technology, and what the technology is capable of for users.





the utility of my model and its reach in terms of audience.

Ultimately the work I have done for my thesis can be grown and developed in many different ways. I can use my model to analyze a historical technology, or I can conduct a larger event study to see if my findings can be duplicated using other industries. I can build a computer program to simulate my models analysis of a technology. I can even further combine my model with other theories to enhance its utility. In the end I am grateful for what I have learned in putting this thesis together, and I look forward to how I will employ it in the future.





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APPENDIX I

id	Company	Date	Title of Press release
1	MSFT	03/09/2005	Microsoft Reveals First Details of Next-Generation Xbox

Number of obs = 120
 F(1, 119) = 688.11
 Prob > F = 0.0000
 R-squared = 0.8526
 Adj R-squared = 0.8513
 Root MSE = .32975

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
market_ret~n	.4899097	.0186761	26.23	0.000	.4529292 .5268902
_cons	7.010715	.6952151	10.08	0.000	5.63412 8.387311

id	Company	Date	Title of Press release
2	MSFT	05/12/2005	Xbox 360 Ushers in the Future of Games and Entertainment

Number of obs = 120
 F(1, 119) = 330.46
 Prob > F = 0.0000
 R-squared = 0.7352
 Adj R-squared = 0.7330
 Root MSE = .48212

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
market_ret~n	.5473704	.0301109	18.18	0.000	.4877479 .6069929
_cons	4.678827	1.124069	4.16	0.000	2.453057 6.904596

id	Company	Date	Title of Press release
3	MSFT	05/18/2005	Premier Titles From Microsoft Game Studios Showcase Awesome Power of Xbox 360

Number of obs = 120
 F(1, 119) = 348.63
 Prob > F = 0.0000





R-squared = 0.7455
 Adj R-squared = 0.7434
 Root MSE = .46124

	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
price						
market_ret~n	.5325129	.0285199	18.67	0.000	.4760406	.5889851
_cons	5.212265	1.062232	4.91	0.000	3.108939	7.315591

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id	Company	Date	Title of Press release
4	MSFT	07/25/2005	Top Japanese Publishers Announce Commitment to Xbox 360

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Number of obs = 120
 F(1, 119) = 80.82
 Prob > F = 0.0000
 R-squared = 0.4044
 Adj R-squared = 0.3994
 Root MSE = .43708

	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
price						
market_ret~n	.3480707	.0387187	8.99	0.000	.2714038	.4247377
_cons	11.80074	1.424642	8.28	0.000	8.979802	14.62167

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id	Company	Date	Title of Press release
5	MSFT	08/17/2005	Microsoft Announces Xbox 360 Price for Europe and North America: Starts at \$299.99

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Number of obs = 120
 F(1, 119) = 162.50
 Prob > F = 0.0000
 R-squared = 0.5773
 Adj R-squared = 0.5737
 Root MSE = .48587

	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
price						
market_ret~n	.4170561	.0327165	12.75	0.000	.3522742	.481838
_cons	9.227052	1.213573	7.60	0.000	6.824055	11.63005

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id	Company	Date	Title of Press release
6	MSFT	09/08/2005	Xbox Live Offers New Levels, Features and Premium Retail Packs to Supercharge Online

-----+





Gaming Experiences on Xbox 360

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Number of obs = 120
 F(1, 119) = 180.61
 Prob > F = 0.0000
 R-squared = 0.6028
 Adj R-squared = 0.5995
 Root MSE = .59548

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.5060824	.0376571	13.44	0.000	.4315177	.5806472
_cons	6.068016	1.403512	4.32	0.000	3.288922	8.847111

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id	Company	Date	Title of Press release
7	MSFT	10/04/2005	Xbox 360 Launch Lineup Announced

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Number of obs = 120
 F(1, 119) = 165.45
 Prob > F = 0.0000
 R-squared = 0.5816
 Adj R-squared = 0.5781
 Root MSE = .54031

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.4286831	.0333275	12.86	0.000	.3626913	.4946748
_cons	9.04672	1.255213	7.21	0.000	6.561273	11.53217

-----+

id	Company	Date	Title of Press release
8	MSFT	10/14/2005	Software Update for Windows XP Media Center Edition 2005 Enables High-Fidelity Access to PC Digital Entertainment via Xbox 360

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Number of obs = 120
 F(1, 119) = 92.08
 Prob > F = 0.0000
 R-squared = 0.4362
 Adj R-squared = 0.4315
 Root MSE = .61625

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.402986	.041996	9.60	0.000	.3198298	.4861422





_cons | 9.943976 1.590468 6.25 0.000 6.794691 13.09326

id	Company	Date	Title of Press release			
9	MSFT	10/19/2005	Microsoft Announces Company's First Cross-Platform Gaming Controller			

Number of obs = 120
 F(1, 119) = 85.58
 Prob > F = 0.0000
 R-squared = 0.4183
 Adj R-squared = 0.4134
 Root MSE = .63524

	price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n		.4232976	.0457566	9.25	0.000	.332695	.5139002
_cons		9.139628	1.735532	5.27	0.000	5.703101	12.57615

id	Company	Date	Title of Press release			
10	MSFT	11/14/2005	Microsoft Announces Xbox 360 Day One Launch Lineup — Strongest Launch in the History of Video Game Consoles			

Number of obs = 120
 F(1, 119) = 92.32
 Prob > F = 0.0000
 R-squared = 0.4369
 Adj R-squared = 0.4321
 Root MSE = .63579

	price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n		.6675179	.0694719	9.61	0.000	.5299566	.8050792
_cons		-.3491728	2.667113	-0.13	0.896	-5.630323	4.931977

id	Company	Date	Title of Press release			
11	NTDOY	03/10/2005	Nintendo President Outlines Bold Vision To Attract New Audiences To Video Games			

Number of obs = 120
 F(1, 119) = 4.86
 Prob > F = 0.0294





R-squared = 0.0392
 Adj R-squared = 0.0312
 Root MSE = .48148

	price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n		.0312313	.0141687	2.20	0.029	.0031759	.0592866
_cons		11.62225	1.24674	9.32	0.000	9.153577	14.09092

id	Company	Date	Title of Press release
12	NTDOY	04/19/2005	Broadcom Announces Partnership with Nintendo to Enable Next Generation Wireless Gaming Consoles

Number of obs = 120
 F(1, 119) = 2.54
 Prob > F = 0.1139
 R-squared = 0.0209
 Adj R-squared = 0.0126
 Root MSE = .56774

	price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n		-.0342765	.0215235	-1.59	0.114	-.0768952	.0083422
_cons		17.31357	1.928422	8.98	0.000	13.49511	21.13204

id	Company	Date	Title of Press release
13	NTDOY	05/17/2005	Breaking News from Nintendo's E3 2005 Press Conference

Number of obs = 120
 F(1, 119) = 0.16
 Prob > F = 0.6864
 R-squared = 0.0014
 Adj R-squared = -0.0070
 Root MSE = .58537

	price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n		.0103828	.0256501	0.40	0.686	-.040407	.0611726
_cons		13.22784	2.303254	5.74	0.000	8.667172	17.78852

id	Company	Date	Title of Press release
14	NTDOY	09/16/2005	Hands on with the Revolution Controller





Number of obs = 120
 F(1, 119) = 0.20
 Prob > F = 0.6537
 R-squared = 0.0017
 Adj R-squared = -0.0067
 Root MSE = .41659

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	-.0052552	.0116858	-0.45	0.654	-.0283942	.0178838
_cons	13.79638	1.03941	13.27	0.000	11.73824	15.85451

+-----+

id	Company	Date	Title of Press release
15	NTDOY	10/05/2005	Nintendo Creates An Easy, Accessible Video Game Network - And It's Free

+-----+

Number of obs = 120
 F(1, 119) = 19.69
 Prob > F = 0.0000
 R-squared = 0.1420
 Adj R-squared = 0.1348
 Root MSE = .43583

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.035016	.0078914	4.44	0.000	.0193902	.0506418
_cons	10.23736	.711919	14.38	0.000	8.827684	11.64703

+-----+

id	Company	Date	Title of Press release
16	NTDOY	11/16/2005	Nintendo Announces Play Control System For Next Hardware

+-----+

Number of obs = 120
 F(1, 119) = 163.24
 Prob > F = 0.0000
 R-squared = 0.5784
 Adj R-squared = 0.5748
 Root MSE = .3482

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.058458	.0045754	12.78	0.000	.0493983	.0675177
_cons	7.958588	.4309323	18.47	0.000	7.105299	8.811876





id	Company	Date	Title of Press release
17	NTDOY	03/23/2006	Nintendo President Challenges Developers To Create Bold New Games

Number of obs = 120
 F(1, 119) = 234.21
 Prob > F = 0.0000
 R-squared = 0.6631
 Adj R-squared = 0.6603
 Root MSE = .99675

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.1961207	.0128151	15.30	0.000	.1707455	.221496
_cons	-6.399417	1.433541	-4.46	0.000	-9.237971	-3.560862

id	Company	Date	Title of Press release
18	NTDOY	05/09/2006	Nintendo Introduces the Next Leap in Video Games

Number of obs = 120
 F(1, 119) = 353.81
 Prob > F = 0.0000
 R-squared = 0.7483
 Adj R-squared = 0.7462
 Root MSE = .91724

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.2327066	.0123716	18.81	0.000	.2082096	.2572035
_cons	-10.81864	1.460703	-7.41	0.000	-13.71097	-7.926299

id	Company	Date	Title of Press release
19	NTDOY	05/25/2006	Nintendo Announces Wii Information, Worldwide Shipments

Number of obs = 120
 F(1, 119) = 225.03
 Prob > F = 0.0000
 R-squared = 0.6541
 Adj R-squared = 0.6512
 Root MSE = 1.1409





price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.2454991	.0163656	15.00	0.000	.2130936	.2779045
_cons	-12.15507	1.969303	-6.17	0.000	-16.05449	-8.255658

id	Company	Date	Title of Press release
20	NTDOY	06/01/2006	Nintendo Rakes in the Accolades for Its Wii Console and Games

Number of obs = 120
 F(1, 119) = 158.38
 Prob > F = 0.0000
 R-squared = 0.5710
 Adj R-squared = 0.5674
 Root MSE = 1.244

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.240456	.0191068	12.58	0.000	.2026227	.2782894
_cons	-11.43139	2.307523	-4.95	0.000	-16.00051	-6.862262

id	Company	Date	Title of Press release
21	NTDOY	06/06/2006	The New York Times Weighs in on Wii and Nintendo DS

Number of obs = 120
 F(1, 119) = 112.54
 Prob > F = 0.0000
 R-squared = 0.4861
 Adj R-squared = 0.4817
 Root MSE = 1.3486

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.2307096	.0217476	10.61	0.000	.1876471	.2737721
_cons	-10.13968	2.632375	-3.85	0.000	-15.35204	-4.927315

id	Company	Date	Title of Press release
22	NTDOY	08/25/2006	Nintendo Announces Two New Wii Titles at the Leipzig Games Convention

Number of obs = 120
 F(1, 119) = 11.70





Prob > F = 0.0009
 R-squared = 0.0895
 Adj R-squared = 0.0819
 Root MSE = 1.9443

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	-.0981188	.0286808	-3.42	0.001	-.1549096	-.0413281
_cons	32.21881	3.460221	9.31	0.000	25.36723	39.07039

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id	Company	Date	Title of Press release
23	NTDOY	09/14/2006	Nintendo's Incomparable Wii Console Launches Nov. 19; MSRP \$249.99

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Number of obs = 120
 F(1, 119) = 14.36
 Prob > F = 0.0002
 R-squared = 0.1077
 Adj R-squared = 0.1002
 Root MSE = 2.1755

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	-.1228006	.0324081	-3.79	0.000	-.1869719	-.0586293
_cons	36.00168	3.915385	9.19	0.000	28.24883	43.75454

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id	Company	Date	Title of Press release
24	NTDOY	11/16/2006	Nintendo's Wii: A Gateway To New Experiences

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Number of obs = 120
 F(1, 119) = 67.53
 Prob > F = 0.0000
 R-squared = 0.3620
 Adj R-squared = 0.3567
 Root MSE = 1.7057

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.3559391	.0433141	8.22	0.000	.2701728	.4417053
_cons	-18.37934	5.109598	-3.60	0.000	-28.49685	-8.261826

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id	Company	Date	Title of Press release
25	SNE	05/10/2004	SONY, SCEI AND IBM TO DEVELOP DIGITAL CONTENT CREATION ENVIRONMENT

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BASED ON CELL PROCESSOR

Number of obs = 120
 F(1, 119) = 180.16
 Prob > F = 0.0000
 R-squared = 0.6022
 Adj R-squared = 0.5989
 Root MSE = 2.0221

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.4600749	.034277	13.42	0.000	.3922031	.5279467
_cons	-.726329	2.891257	-0.25	0.802	-6.451306	4.998648

id	Company	Date	Title of Press release
26	SNE	09/21/2004	SONY COMPUTER ENTERTAINMENT INC ADOPTS BLU-RAY DISC ROM FOR NEXT GENERATION PLAYSTATION®

Number of obs = 120
 F(1, 119) = 555.85
 Prob > F = 0.0000
 R-squared = 0.8237
 Adj R-squared = 0.8222
 Root MSE = 1.1639

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.6275018	.0266157	23.58	0.000	.5748001	.6802035
_cons	-17.72831	2.302623	-7.70	0.000	-22.28773	-13.16888

id	Company	Date	Title of Press release
27	SNE	11/29/2004	IBM, Sony, Sony Computer Entertainment Inc. and Toshiba Unveil Cell Processor

Number of obs = 120
 F(1, 119) = 473.83
 Prob > F = 0.0000
 R-squared = 0.7993
 Adj R-squared = 0.7976
 Root MSE = .5883

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
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```
market_ret~n | .5383503 .0247317 21.77 0.000 .489379 .5873216
_cons | -10.95569 2.109464 -5.19 0.000 -15.13264 -6.778744
```

```
+-----+
id   Company Date           Title of Press release
28     SNE       12/07/2004      Sony and nVidia Announce joint GPU development
+-----+
```

Number of obs = 120
 F(1, 119) = 513.13
 Prob > F = 0.0000
 R-squared = 0.8117
 Adj R-squared = 0.8102
 Root MSE = .56425

```
price      Coef.      Std. Err.   t      P>t      [95% Conf. Interval]
market_ret~n | .5189291 .0229084 22.65 0.000 .4735682 .56429
_cons | -9.372238 1.95694 -4.79 0.000 -13.24717 -5.497302
```

```
+-----+
id   Company Date           Title of Press release
29     SNE       05/16/2005      SONY COMPUTER ENTERTAINMENT INC. TO
LAUNCH ITS NEXT GENERATION
COMPUTER ENTERTAINMENT SYSTEM,
PLAYSTATION 3 IN SPRING 2006
+-----+
```

Number of obs = 120
 F(1, 119) = 102.20
 Prob > F = 0.0000
 R-squared = 0.4620
 Adj R-squared = 0.4575
 Root MSE = 1.0905

```
price      Coef.      Std. Err.   t      P>t      [95% Conf. Interval]
market_ret~n | .4873448 .048206 10.11 0.000 .3918921 .5827975
_cons | -5.992025 4.329597 -1.38 0.169 -14.56506 2.581009
```

```
+-----+
id   Company Date           Title of Press release
30     SNE       07/21/2005      SONY COMPUTER ENTERTAINMENT TO
ACQUIRE SN SYSTEMS ProDG To Become Part
of PS3 Software Development Kit
+-----+
```

Number of obs = 120





Number of obs = 120
 F(1, 119) = 133.18
 Prob > F = 0.0000
 R-squared = 0.5281
 Adj R-squared = 0.5241
 Root MSE = 1.245

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.5536556	.0479756	11.54	0.000	.4586592	.6486521
_cons	-11.88062	4.25801	-2.79	0.006	-20.3119	-3.449331

-----+

id	Company	Date	Title of Press release
31	SNE	09/27/2005	SONY COMPUTER ENTERTAINMENT TO START PROVIDING PRODG TOOLS FOR PLAYSTATION®3 GAME CONTENT DEVELOPMENT

-----+

Number of obs = 120
 F(1, 119) = 4.00
 Prob > F = 0.0478
 R-squared = 0.0325
 Adj R-squared = 0.0244
 Root MSE = 1.7876

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	-.0801039	.0400482	-2.00	0.048	-.1594033	-.0008044
_cons	42.73372	3.585417	11.92	0.000	35.63424	49.8332

-----+

id	Company	Date	Title of Press release
32	SNE	04/17/2006	PLAYSTATION®3 LAUNCHES WORLDWIDE IN EARLY NOVEMBER 2006

-----+

Number of obs = 120
 F(1, 119) = 435.52
 Prob > F = 0.0000
 R-squared = 0.7854
 Adj R-squared = 0.7836
 Root MSE = 2.675

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.7027766	.0336755	20.87	0.000	.6360956	.7694575
_cons	-38.96389	3.86422	-10.08	0.000	-46.61543	-31.31235





id	Company	Date	Title of Press release
33	SNE	04/21/2006	SONY COMPUTER ENTERTAINMENT AMERICA ANNOUNCES WIDESPREAD PRESENCE AT THE 2006 GAME DEVELOPERS CONFERENCE (GDC)

Number of obs = 120
 F(1, 119) = 408.85
 Prob > F = 0.0000
 R-squared = 0.7746
 Adj R-squared = 0.7727
 Root MSE = 2.6766

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
market_ret~n	.7072618	.0349784	20.22	0.000	.638001 .7765225
_cons	-39.59355	4.042752	-9.79	0.000	-47.5986 -31.5885

id	Company	Date	Title of Press release
34	SNE	05/08/2006	SCE ANNOUNCES NEW CONTROLLER FOR PLAYSTATION®3

Number of obs = 120
 F(1, 119) = 329.68
 Prob > F = 0.0000
 R-squared = 0.7348
 Adj R-squared = 0.7325
 Root MSE = 2.6996

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
market_ret~n	.663133	.0365222	18.16	0.000	.5908155 .7354506
_cons	-34.40788	4.30437	-7.99	0.000	-42.93096 -25.88479

id	Company	Date	Title of Press release
35	SNE	09/22/2006	PLAYSTATION®3 HDD 20GB EQUIPPED WITH HDMI AS STANDARD

Number of obs = 120
 F(1, 119) = 500.28
 Prob > F = 0.0000





R-squared = 0.8078
 Adj R-squared = 0.8062
 Root MSE = 1.2732

	price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n		.4215299	.0188462	22.37	0.000	.3842127	.4588472
_cons		-5.894864	2.273442	-2.59	0.011	-10.39651	-1.393223

+-----+
id Company Date Title of Press release
 36 SNE 10/03/2006 ACCESSORIES FOR PLAYSTATION®3
 BECOME AVAILABLE
 +-----+

Number of obs = 120
 F(1, 119) = 438.19
 Prob > F = 0.0000
 R-squared = 0.7864
 Adj R-squared = 0.7846
 Root MSE = 1.377

	price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n		.4339047	.0207282	20.93	0.000	.3928608	.4749487
_cons		-7.49719	2.489673	-3.01	0.003	-12.42699	-2.567388

+-----+
id Company Date Title of Press release
 37 SNE 10/19/2006 SONY COMPUTER ENTERTAINMENT
 AMERICA ANNOUNCES EXTENSIVE LINE UP
 OF GAME TITLES FOR PLAYSTATION®3
 +-----+

Number of obs = 120
 F(1, 119) = 144.45
 Prob > F = 0.0000
 R-squared = 0.5483
 Adj R-squared = 0.5445
 Root MSE = 1.9918

	price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n		.3887067	.0323418	12.02	0.000	.3246667	.4527468
_cons		-2.78436	3.861608	-0.72	0.472	-10.43073	4.86201

+-----+
id Company Date Title of Press release
 38 SNE 11/17/2006 PLAYSTATION®3 LAUNCHES NEXT
 +-----+





GENERATION OF ENTERTAINMENT IN NORTH AMERICA

+-----+-----+

Number of obs = 120
F(1, 119) = 4.66
Prob > F = 0.0330
R-squared = 0.0376
Adj R-squared = 0.0296
Root MSE = 2.0307

price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
market_ret~n	.1114958	.0516755	2.16	0.033	.0091732	.2138184
_cons	29.1205	6.095454	4.78	0.000	17.05089	41.19011





APPENDIX II (Code)¹⁵³

```
use "C:\Documents and Settings\AB\Desktop\event_dates.dta"
sort company_id event_date
by company_id: gen eventcount=_N
by company_id: keep if _n==1
sort company_id
keep company_id eventcount
save eventcount.dta, replace
clear
use "C:\Documents and Settings\AB\Desktop\stockdata.dta"
sort company_id
merge company_id using eventcount
tab _merge
keep if _merge==3
drop _merge
expand eventcount
drop eventcount
sort company_id date
by company_id date: gen set=_n
sort company_id set
save stockdata2, replace
use "C:\Documents and Settings\AB\Desktop\event_dates.dta"
by company_id: gen set=_n
sort company_id set
save dates2, replace
use stockdata2
merge company_id set using dates2
tab _merge
drop _merge
egen group_id = group(company_id set)
sort group_id date
by group_id: gen datenum=_n
by group_id: gen target=datenum if date==event_date
egen td=min(target), by(group_id)
drop target
gen dif=datenum-td
by group_id: gen event_window=1 if dif>=-2 & dif<=2
egen count_event_obs=count(event_window), by(group_id)
by group_id: gen estimation_window=1 if dif<=-3 & dif>=-123
egen count_est_obs=count(estimation_window), by(group_id)
replace event_window=0 if event_window==.
```

¹⁵³ I used Princeton University library's Data and Statistical Services website to construct this code. Here is the website: http://dss.princeton.edu/online_help/analysis/event_studies.htm (accessed on 5/5/2007)





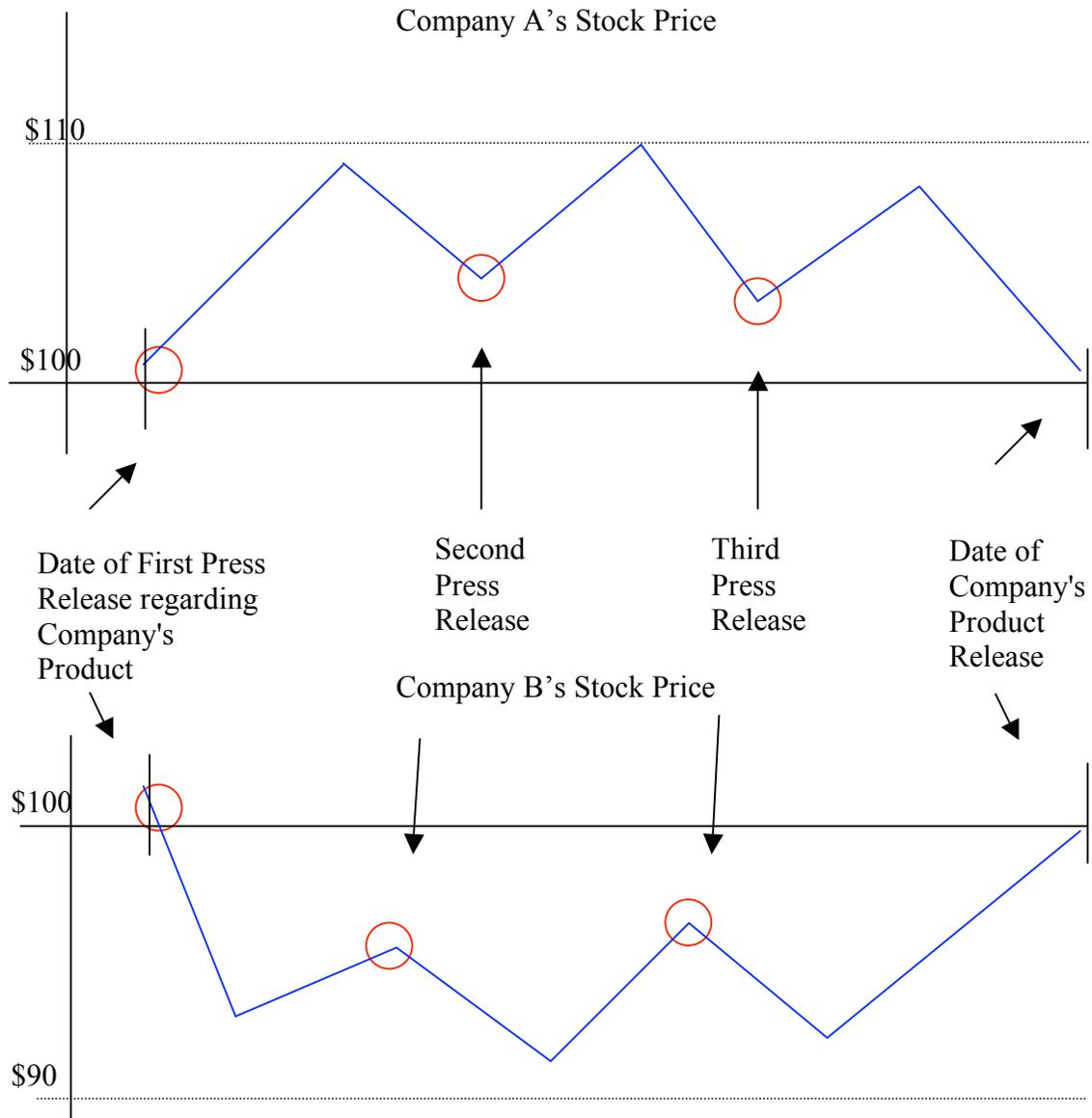
```
replace estimation_window=0 if estimation_window==.
tab company_id if count_event_obs<5
tab company_id if count_est_obs<120
drop if count_event_obs < 5
drop if count_est_obs < 120
drop count_est_obs
drop count_event_obs
set more off
gen predicted_return=.
egen id=group(group_id)
forvalues i=1(1)38 { /*note: replace N with the highest value of id */
l id company_id if id==`i' & dif==0
reg price market_return if id==`i' & estimation_window==1
predict p if id==`i'
replace predicted_return = p if id==`i' & event_window==1
drop p
}
sort id date
gen abnormal_return=price-predicted_return if event_window==1
by id: egen cumulative_abnormal_return = sum(abnormal_return)
sort id date
by id: egen ar_sd = sd(abnormal_return)
gen test =(1/(5)) * (cumulative_abnormal_return/ar_sd)
gen cumlative_abnormal_daily= cumulative_abnormal_return/5
gen percentage_change= cumlative_abnormal_daily/ price if dif==0
list company_id percentage_change test if dif==0
reg cumulative_abnormal_return if dif==0, robust
reg cumulative_abnormal_return if dif==0 & company_id=="SNE", robust
reg cumulative_abnormal_return if dif==0 & company_id=="NTDOY", robust
reg cumulative_abnormal_return if dif==0 & company_id=="MSFT", robust
```





APPENDIX III

Hypothetical Example



The aggregate movement in stock prices on the press release dates for product A is correlated with an increase in the value of its company's stock, but the reverse is true with product B. Based on the information available, I claim that the stock market and my econometrics model would predict that product A would be more readily adopted than product B.





APPENDIX IV¹⁵⁴

Stock Prices for each company during the period of their event study

Microsoft's 360:



Nintendo's Wii



¹⁵⁴ Charts were generated by Yahoo Finance





Sony's PS3:





APPENDIX V¹⁵⁵

Stock Prices for Sony, the Exchange Fund ITF, and a comparison of the two for the estimation window for Sony's press release on 10/03/2006 "ACCESSORIES FOR PLAYSTATION®3 BECOME AVAILABLE"

ITF's Stock price:



Sony's Stock Price:



¹⁵⁵ Charts were generated by Yahoo Finance





Comparison of Sony and ITF:





APPENDIX VI

Sony PS3 Press Release:

SONY COMPUTER ENTERTAINMENT INC. TO LAUNCH ITS NEXT GENERATION COMPUTER ENTERTAINMENT SYSTEM, PLAYSTATION 3 IN SPRING 2006

Unrivaled Performance with the Introduction of Cell Processor and Many Advanced Technologies, and Backwards compatible with PlayStation® and PlayStation®2

Los Angeles, CALIF., May 16, 2005 – At a press conference held in Los Angeles, California, today, Sony Computer Entertainment Inc. (SCEI) revealed the outline of its PLAYSTATION®3 (PS3) computer entertainment system, incorporating the world’s most advanced Cell processor with super computer like power. Prototypes of PS3 will also be showcased at the Electronic Entertainment Expo (E3), the world’s largest interactive entertainment exhibition held in Los Angeles, from May 18th to 20th. PS3 combines state-of-the-art technologies featuring Cell, a processor jointly developed by IBM, Sony Group and Toshiba Corporation, graphics processor (RSX) co-developed by NVIDIA Corporation and SCEI, and XDR memory developed by Rambus Inc. It also adopts BD-ROM (Blu-ray Disc ROM) with maximum storage capacity of 54 GB (dual layer), enabling delivery of entertainment content in full high-definition (HD) quality, under a secure environment made possible through the most advanced copyright protection technology. To match the accelerating convergence of digital consumer electronics and computer technology, PS3 supports high quality display in resolution of 1080p¹⁵⁶ as standard, which is far superior to 720p/1080i.

With an overwhelming computing power of 2 teraflops, entirely new graphical expressions that have never been seen before will become possible. In games, not only will movement of characters and objects be far more refined and realistic, but landscapes and virtual worlds can also be rendered in real-time, thereby elevating the freedom of graphics expression to levels not experienced in the past. Gamers will literally be able to dive into the realistic world seen in large screen movies and experience the excitement in real-time. In 1994, SCEI launched the original PlayStation® (PS), followed by PlayStation®2 (PS2) in 2000 and PlayStation®Portable (PSP®) in 2004, every time introducing the latest advancement in technology and bringing innovation to the interactive entertainment software creation. Over 13,000 titles have been developed by now, creating a software market that sells more than 250 million copies annually. PS3 offers backward compatibility enabling gamers to enjoy these enormous assets from PS

¹⁵⁶ 1080p/720p/1080i: “p” stands for progressive scan method, “i” stands for interlace method. 1080p is the highest resolution within the HD standard.





and PS2 platforms.

PlayStation family of products are sold in more than 120 countries and regions around the world. With cumulative shipments reaching more than 102 million for PS and approximately 89 million for PS2, they are the undisputed leaders and have become the standard platform for home entertainment. After 12 years from the introduction of the original PS and 6 years from the launch of PS2, SCEI brings PS3, the newest platform with the most advanced next generation computer entertainment technology.

With the delivery of Cell based development tools that has already begun, development of game titles as well as tools and middleware are in progress. Through collaboration with world's leading tools and middleware companies, SCEI will offer full support to new content creation by providing developers with extensive tools and libraries that will bring out the power of the Cell processor and enable efficient software development.

Preparations are under way for launch of PS3 and new generation software in the spring of 2006.

“SCEI has continuously brought innovation to the world of computer entertainment, such as real-time 3D computer graphics on PlayStation and the world's first 128 bit processor Emotion Engine (EE) for PlayStation 2. Empowered by the Cell processor with super computer like performance, a new age of PLAYSTATION 3 is about to begin. Together with content creators from all over the world, SCEI will accelerate the arrival of a new era in computer entertainment.”

Ken Kutaragi, President and CEO, Sony Computer Entertainment Inc..

Supporting comments from third party developers and publishers
(In alphabetical order of company name)

“With the new generation PlayStation platform, we can create “GUNDAM WORLD” with the quality no one has ever imagined. The philosophy, connecting millions of Cell together, makes reality get closer to the world of SF films. We are delighted to share the vision of Ken, ARCHITECT, Kutaragi.”

Shin Unozawa, Managing Director, Leader, Game Software Group,
President, Video Game Company, BANDAI CO.,LTD.

“The PLAYSTATION 3 has us really excited! So much so in fact that we are already working our hardest to get Devil May Cry 4 out for this new platform. New hardware always yields more options for developers to create exciting and fresh gameplay experiences. I believe that the PS3 is one piece of hardware that will test the mettle of our development team and help us to create some of the most amazing games, limited only by our imagination.”

Keiji Inafune, Managing Executive Officer, Research & Development Division,
Capcom Co., Ltd.

“Each generation of PlayStation has made a dramatic improvement in how we create and play videogames. PLAYSTATION 3 will be a breakthrough in how the world





experiences entertainment. EA is fully aligned with Sony Computer Entertainment – we share their vision and applaud their success. ”

Larry Probst, Chairman and CEO, Electronic Arts

“President Kutaragi has thrown down a gauntlet. That gauntlet is called the PLAYSTATION 3. We here at Koei have gladly taken up the challenge, and are striving day and night to take full advantage of all the PS3's new possibilities. Our goal is to combine cutting-edge technology with a full range of artistic expression to deliver the ultimate form of entertainment, and please people everywhere.”

Keiko Erikawa, Chairman & C.E.O., KOEI Co., Ltd.

“With the arrival of the next generation computer entertainment system PLAYSTATION 3, I believe it will be possible for graphic expressions, more beautiful than before, to coexist with more deep and evolved game play which utilize the Cell architecture. I also have high expectations for the evolution by the online features that will be enhanced. We will utilize the features of the new platform and will strive to create contents that will bring new excitement for our users world wide, so please have high hopes for Konami. ”

Kazumi Kitau, CEO, Konami Digital Entertainment, Inc

“Each time SCEI launches a console, the video games business moves to the next level. With PLAYSTATION 3 it looks as if it might be time for interactive entertainment to become, finally, the world's dominant artistic medium. ”

Sam Houser, President, Rockstar Games (Take-Two Interactive Software, Inc.)

“We at Namco have used and will continue to use the advancements in audio-visual technology to deliver games that are not only appealing to the eyes and ears, but that stir emotions, speak to the heart, and remain in players’ minds for years to come. We are confident that the PLAYSTATION 3 is an entertainment system that will enable us to do just that.”

Shigeru Yokoyama, CT Company President, Namco Ltd.

“Next-generation hardware platforms will enable SEGA to create new game concepts that offer more immersive interactive experiences. SEGA continues to pursue the fusion of creativity and technology by publishing only the best, more innovative content to gamers around the world.”

Hisao Oguchi, President and Chief Operating Officer, SEGA Corporation

“Square Enix is extremely honored to have had the chance to provide you with this technical demonstration of what the Cell processor can bring to the PLAYSTATION 3 and the world of gaming. We are committed to fully backing SCEI’s new computer entertainment system and plans to bring the FINAL FANTASY series to the PS3 are just beyond the horizon.”

Yoichi Wada, President, SQUARE ENIX CO., LTD.

“Ubisoft was one of the first major international developers to have its teams start focusing on next generation consoles. We are looking forward to developing outstanding





games on Sony Computer Entertainment Inc.'s new system. Its powerful features will help take the industry to an even higher level in the very near future."

Yves Guillemot, President and CEO, Ubisoft

<PLAYSTATION®3 Specifications>

Product name PLAYSTATION®3

Logo

CPU Cell Processor

PowerPC-base Core @3.2GHz

1 VMX vector unit per core

512KB L2 cache

7 x SPE @3.2GHz

7 x 128b 128 SIMD GPRs

7 x 256KB SRAM for SPE

* 1 of 8 SPEs reserved for redundancy

total floating point performance : 218 GFLOPS

GPU RSX @550MHz

1.8 TFLOPS floating point performance

Full HD (up to 1080p) x 2 channels

Multi-way programmable parallel floating point shader

pipelines

Sound Dolby 5.1ch, DTS, LPCM, etc. (Cell-base processing)

Memory 256MB XDR Main RAM @3.2GHz

256MB GDDR3 VRAM @700MHz

System Bandwidth Main RAM 25.6GB/s

VRAM 22.4GB/s

RSX 20GB/s (write) + 15GB/s (read)

SB 2.5GB/s (write) + 2.5GB/s (read)

System Floating Point Performance 2 TFLOPS

Storage HDD Detachable 2.5" HDD slot x 1

USB Front x 4, Rear x 2 (USB2.0)

Memory Stick standard/Duo, PRO x 1

SD standard/mini x 1

I/O

CompactFlash (Type I, II) x 1

Ethernet (10BASE-T, 100BASE-TX, 1000BASE-T) x 3

(input x 1 + output x 2)

Wi-Fi IEEE 802.11 b/g

Communication

Bluetooth Bluetooth 2.0 (EDR)

Controller Bluetooth (up to 7)

USB2.0 (wired)

Wi-Fi (PSP®)

Network (over IP)

Screen size 480i, 480p, 720p, 1080i, 1080p

HDMI HDMI out x 2

Analog AV MULTI OUT x 1

AV Output

Digital audio DIGITAL OUT (OPTICAL) x 1

CD PlayStation® CD-ROM

PlayStation®2 CD-ROM

CD-DA CD-DA (ROM), CD-R, CD-RW

Super Audio CD Hybrid disc(HD layer/CD layer), HD layer

DualDisc DualDisc (audio side), DualDisc (DVD side)

PlayStation®2 DVD-ROM

PLAYSTATION®3 DVD-ROM

DVD

DVD-Video DVD-ROM, DVD-R, DVD-RW, DVD+R,

DVD+RW

PLAYSTATION®3 BD-ROM

Disc media

* read only





Blu-ray Disc
BD-Video BD-ROM, BD-R, BD-RE

About Sony Computer Entertainment Inc.

Recognized as the global leader and company responsible for the progression of consumer-based computer entertainment, Sony Computer Entertainment Inc. (SCEI) manufactures, distributes and markets the PlayStation® game console, the PlayStation®2 computer entertainment system and the PlayStation®Portable (PSP®) handheld entertainment system. PlayStation has revolutionized home entertainment by introducing advanced 3D graphic processing, and PlayStation 2 further enhances the PlayStation legacy as the core of home networked entertainment. PSP is a new portable entertainment system that allows users to enjoy 3D games, with high-quality full-motion video, and high-fidelity stereo audio. SCEI, along with its subsidiary divisions Sony Computer Entertainment America Inc., Sony Computer Entertainment Europe Ltd., and Sony Computer Entertainment Korea Inc. develops, publishes, markets and distributes software, and manages the third party licensing programs for these platforms in the respective markets worldwide. Headquartered in Tokyo, Japan, Sony Computer Entertainment Inc. is an independent business unit of the Sony Group.

* Storage media (HDD, “Memory Stick”, SD memory card, and CompactFlash) are sold separately.

* “Dolby” is a trademark of Dolby Laboratories.

* “DTS” is a trademark of Digital Theater Systems, Inc.

* “CompactFlash” is a trademark of SanDisk Corporation.

* “HDMI” is a trademark of HDMI Licensing LLC.

* “Blu-ray Disc” is a trademark.

* “Bluetooth” is a trademark of Bluetooth SIG, Inc.

* All other trademarks are the property of their respective owners.

* “Memory Stick” and “Memory Stick PRO” are trademarks of Sony Corporation.

* “PlayStation”, the PlayStation logo and “PSP” are registered trademarks of Sony Computer Entertainment Inc.

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Design and specifications are subject to change without notice.

XBOX 360 Press Release:

Xbox 360 Ushers in the Future of Games and Entertainment
Highly anticipated video game console is unveiled on an MTV special.
Press Releases:

NEW YORK — May 12, 2005 —Celebrating the dawn of a new era in entertainment, millions of game fanatics around the globe came together tonight for the televised unveiling of the Xbox 360™ future-generation game and entertainment system from Microsoft. An audience of millions watched "MTV Presents: The Next-Generation Xbox Revealed" as celebrities, professional athletes, musicians and Xbox officials took the wraps off the much-anticipated system, ending months of intense speculation and





satiating consumers worldwide.

The sleek new Xbox 360™ video game console and matching Xbox® Wireless Controller debuted on MTV Thursday, May 12.

The sleek new Xbox 360™ video game console and matching Xbox® Wireless Controller debuted on MTV Thursday, May 12.

Click image for high-res version.

The new Xbox 360 system places players at the center of powerful next-generation games and entertainment experiences. The elegant design features a breakthrough wireless controller and an array of Faces, interchangeable faceplates that let gamers personalize their console. The unveiling spotlighted some of the groundbreaking games in development for the new Xbox 360 system, advancements for the XboxLive™ service — the only unified console gaming service— and new digital media experiences that only Xbox 360 can deliver.

"With the first generation of Xbox, our ambition was to change the way people think about video games," said Robbie Bach, chief Xbox officer at Microsoft. "Starting today with Xbox 360, our ambition is to transform the way people play games and have fun."

Xbox 360 will unleash the greatest game lineup in the history of video games when it launches in North America, Europe and Japan this Christmas holiday. The games that captured the color, drama and fun of high-definition gameplay at the MTV unveiling included 2K Sports' "NBA 2K6"; Activision Publishing Inc.'s "Call of Duty® 2" and "Tony Hawk's American Wasteland™", along with id Software's "QUAKE 4™"; Electronic Arts' "Madden NFL 06," "Need for Speed™ Most Wanted" and "Tiger Woods PGA TOUR® 06"; Majesco Entertainment's "The Darkness"; Microsoft Game Studios' "Perfect Dark: Zero™," "Kameo™: Elements of Power™," "Project Gotham Racing™ 3" and "Gears of War"; THQ Inc.'s "Saint's Row"; and Ubisoft Entertainment's "Ghost Recon 3."

The Platform and Partners Power the Portfolio

Xbox 360 ignites a new era of digital entertainment that is always connected, always personalized and always in high definition. It is the only system designed with a singular platform vision that combines the most-powerful hardware with intelligent software and services advancements.

Every Xbox 360 game is designed for high-definition, wide-screen televisions. Regardless of the television Xbox 360 connects to, gamers will experience smooth, cinematic experiences that far exceed anything they've seen or felt in games before. And these experiences are never more than a click away. The Xbox Guide Button is the launch pad that connects gamers to their games, friends and music from the wireless controller.

With more than one teraflop of system-floating point performance, a three-core PowerPC-based CPU for the most-advanced artificial intelligence and physics processing, a custom ATI graphics processor, and more than 512 MB of memory for the





ultimate in visual fidelity, the Xbox 360 hardware is a perfect blend of power, elegance and balance. Xbox 360 also features software so smart it remembers what gamers have achieved, continually evolving and enhancing the game experience. When the system is combined with unrivaled Microsoft® XNA™ software development tools, game creators can produce truly believable, thriving worlds.

Fabled game studios such as BioWare Corp., Bizarre Creations Ltd., Bungie Studios and Rare Ltd., as well as legendary Japanese game creators Hironobu Sakaguchi, Tetsuya Mizuguchi, and Yoshiki Okamoto, are harnessing the powerful Xbox 360 platform to create exclusive games for Microsoft Game Studios. Equally commanding, game-changing publishers such as 2K Games, Activision Publishing Inc., Capcom Co. Ltd., Electronic Arts, Tecmo Inc., Namco Hometek Inc., Rockstar Games, SEGA of America Inc., THQ and Ubisoft Entertainment — just to name a few — are flocking to Xbox 360.

"Xbox 360 marks the beginning of a renaissance in video games," said Don Mattrick, president of Worldwide Studios for Electronic Arts. "The unbelievable Xbox 360 games in development at Electronic Arts will accelerate the industry's mission to make video games the pre-eminent form of all entertainment."

"With Xbox 360, a new chapter in video game history is being written," said Kathy Vrabeck, president of Activision Publishing. "The platform liberates us to achieve new levels of graphics and gameplay so our audiences connect emotionally with more riveting stories, more believable characters and more open, living worlds."

XboxLive: New Levels of Service Get Everyone in the Game

Connect Xbox 360 to a broadband connection and get instant access to XboxLiveSilver, available for no monthly service charge with an Xbox 360 system. Players can express their digital identity through their Gamer Profile; connect with friends anytime, anywhere through XboxLivevoice chat; send and receive text and voice message; and access XboxLiveMarketplace to download demos and trailers along with new game levels, maps, weapons, vehicles, skins, classic arcade and card and board games, community-created content, and more to the detachable Xbox 360 hard drive — all right out of the box at no extra cost. Composed of user-generated information such as Achievements (rewards players have earned in games), Gamerzone (style of play), and a custom-created Gamertile (a visual icon to represent the gamer online), the Gamer Profile makes it easy to connect with the XboxLivecommunity.

Gamers who subscribe to the premium service, XboxLiveGold, can experience the thrill of multiplayer online gameplay. Gamer Profiles will provide a foundation for intelligent matchmaking, so players of similar skill levels and interests can quickly and easily connect, and the XboxLiveCamera peripheral will let gamers add their faces into games and see their friends while they play. Other XboxLiveGold features for premium members include video messaging; online tournaments and ladders; and exclusive, original programming such as playing with celebrities online and joining sponsored tournaments to win prizes. And all Xbox 360 owners new to XboxLive will kick-start





their experience with a free month of the full subscription service, which will let them experience the full power of XboxLive.

Unlock a New World of Digital Entertainment

With Xbox 360, gamers are always on. At its core, Xbox 360 is an amazing game machine with a wide selection of titles. But it is also an entertainment system that lets people power new experiences. Every Xbox 360 system has built-in progressive-scan DVD movie, CD music and photo playback support. The integration of XboxLive into the system lets players receive game invitations from friends while they're watching movies or listening to music. And every MP3 player, digital camera and Windows® XP-based PC with a Universal Serial Bus (USB) 2.0 port can plug right into an Xbox 360 system to stream music and photos.

In addition, with built-in Media Center Extender functionality in every system, Xbox 360 players can access recorded TV and digital movies, music, video and photos stored on Windows XP Media Center Edition 2005-based PCs through any Xbox 360 system in the house.

Xbox 360 also opens the door to incredible, new high-definition entertainment. In addition to optimizing all Xbox 360 games for high definition, Xbox 360 will stream high-definition TV and movies stored on Media Center PCs starting this holiday season. As high-definition entertainment becomes more pervasive, Microsoft will offer more ways to experience HDTV and movies in any room in the house, any way people want it. Whether it's by the dropping of an optical disc in a drive, streaming to Xbox 360, or through broadband distribution, Xbox 360 will let players choose how to light up their high-definition content.

"Xbox 360 is a revolution that promises to ignite new levels of creativity, community and competition," Bach said. "Tonight's unveiling is a signal to the world that the next generation of gaming is here."

About Xbox 360

Xbox 360 is the future-generation video game and entertainment system that places gamers at the center of the experience. Available this holiday season in North America, Europe and Japan, Xbox 360 will ignite a new era of digital entertainment that is always connected, always personalized and always in high definition.

About XboxLive

Now in its third generation of transforming and uniting Xbox game communities, with more than 300 games planned by end of holiday 2005 and now with presence in 24 countries worldwide, XboxLive has set the bar for online games entertainment. As the first global, unified online console games service, XboxLive continues to take online gameplay and entertainment to unprecedented heights. With a rapidly growing global





community, XboxLiveoffers best-in-class games, intelligent matchmaking, tournaments, unique programming and integration with Xbox.com — there is simply nothing else like it. The service continues to provide more and more ways for members to meet, interact and stay engaged with each other.

About Microsoft

Founded in 1975, Microsoft (Nasdaq "MSFT") is the worldwide leader in software, services and solutions that help people and businesses realize their full potential.

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Nintendo Wii Press Release:

Nintendo Reveals 'Revolution'-ary Controller In Keynote Speech

Press Release PROVIDED BY GAMES PRESS

TOKYO, Sept. 16, 2005 - Every gamer who plays. Every one who used to play. Even those who have yet to play, Nintendo is your bet.

As the cornerstone of his speech today at the Tokyo Game Show's annual event, Nintendo President Satoru Iwata elaborated on the theme of the company's aim and





proven ability to broaden the population of video game players. Two shining examples highlighted in his keynote include the smash-hit sales of the highly innovative Nintendogs™ game for the portable Nintendo DSTM system, and the new controller that will be central to the company's upcoming console system, code-named Revolution.

Nintendo breaks with more than 20 years of video game history by abandoning the traditional controller held with two hands and introducing an all-new freehand-style unit held with one hand.

The intuitive, pioneering interface allows players to run, jump, spin, slide, shoot, steer, accelerate, bank, dive, kick, throw and score in a way never experienced in the history of gaming.

"The feeling is so natural and real, as soon as players use the controller, their minds will spin with the possibilities of how this will change gaming as we know it today," explains Satoru Iwata, Nintendo president. "This is an extremely exciting innovation - one that will thrill current players and entice new ones."

When picked up and pointed at the screen, the controller gives a lightning-quick element of interaction, sensing motion, depth, positioning and targeting dictated by movement of the controller itself.

The controller also allows for a variety of expansions, including a "nunchuk" style analog unit offering the enhanced game-play control hard-core gamers demand.

The response from all major publishers worldwide has been extremely positive. Beyond its other innovations, the new controller gives third parties flexibility, allowing them the option to use as many or as few of the controller features as they desire. In addition, incorporated technology will easily allow games from the NES®, SNES®, N64® and Nintendo GameCube™ generations to be controlled in familiar fashion.

Nintendogs for the DS, a virtual and sophisticated dogfest, has taken the gaming world by storm, already selling more than 1.5 million units in Japan and North America combined. The game, just as Iwata believes the Revolution controller will do, is exciting current game players and attracting hordes of new consumers into the playing world.

The worldwide leader and innovator in the creation of interactive entertainment, Nintendo Co., Ltd., of Kyoto, Japan, manufactures and markets hardware and software for its popular home and portable video game systems. Each year, hundreds of all-new titles for the best-selling Game Boy® Advance SP, Nintendo DSTM and Nintendo GameCube™ systems extend Nintendo's vast game library and continue the tradition of delivering a rich, diverse mix of quality video games for players of all ages. Since the release of its first home video game system in 1983, Nintendo has sold more than 2 billion video games and more than 353 million hardware units globally, creating enduring industry icons such as Mario™ and Donkey Kong® and launching popular culture franchise phenomena such as Metroid®, Zelda™ and Pokémon®. A wholly owned





subsidiary, Nintendo of America Inc., based in Redmond, Wash., serves as headquarters for Nintendo's operations in the Western Hemisphere.

For more information about Nintendo, visit the company's Web site at www.nintendo.com.

NOTE: Publisher quotes:

"Nintendo has long been a trailblazer, and this controller design reinforces that reputation," said Brian Farrell, president and CEO of THQ. "We enthusiastically support Nintendo's next console because we believe their approach of continual innovation is very much in line with our own strategy of creating unique and innovative games for the next generation of hardware."

"What we're seeing from this controller is the same thing we saw with Nintendo DS," said Chuck Huebner, Head of Worldwide Studios, Activision, Inc. "It's a system that's designed with an eye on enticing new players to the video game industry, and that's something we firmly support."

"Game control is essential - it's the area where perhaps the most game-play improvement can be made," said John Schappert, Sr. Vice President and General Manager of Electronic Arts Canada. "While our portfolio represents a full array of titles across all genres, I think our sports titles might be the first to immediately take advantage of what this novel 'freehand' type of control has to offer."

"We were among the first publishers to see the control design in action," said Serge Hascoet, Chief Creative Officer of Ubisoft. "We're excited about the new controller and are looking forward to taking advantage of its innovative aspects."

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APPENDIX VII

Sony's press release for 10/03/2006:

ACCESSORIES FOR PLAYSTATION®3 BECOME AVAILABLE Wireless Controller (SIXAXISTM), Memory Card Adaptor and BD Remote Control

Tokyo, October 3, 2006 – Sony Computer Entertainment Inc. (SCEI) today announced that

Wireless Controller (SIXAXISTM) and Memory Card Adaptor would become available simultaneously with the launch of PLAYSTATION®3 (PS3) computer entertainment system on November 11th, 2006, in Japan, at a recommended retail price of 5,000 yen (tax included) and 1,500 yen (tax included) respectively. BD Remote Control will also become available on

December 7th 2006, at a recommended retail price of 3,600 yen (tax included).

Wireless Controller (SIXAXIS) for PS3 employs a high-precision, highly sensitive six-axis sensing system, which detects natural and intuitive movements of hands for real-time interactive play. With the adoption of Bluetooth® wireless technology, it allows up to 7 players to play at the same time, without having to attach any other external device such as a multitap. In addition, by simply plugging a USB cable to the controller, users can seamlessly switch from wireless to wired connection and automatically charge its battery while the controller is in use. Controller battery lasts up to 30 hours when fully charged

*1). The new Memory Card Adaptor enables users to transfer data saved on Memory Cards for PlayStation® and PlayStation®2 onto the hard disk drive of PS3. To transfer data, users need to simply insert their Memory Cards to the Memory Card Adaptor connected to PS3 via a USB port. In December, BD Remote Control will also become available, which enables users to easily operate movies and music content on BD (Blu-ray Disc) and DVD on PS3.

While further enhancing the joy of entertainment on PlayStation 2 and PSP® (PlayStation®Portable), SCEI will vigorously promote PS3 as the next generation computer entertainment platform.

(*) SCE actual measurement, measured under room temperature with a fully charged fresh battery.

<Separately Sold Accessories>

Product name Wireless Controller (SIXAXISTM)
Product Code CECHZC1J
Release Date (in Japan) Saturday, November 11th, 2006
Recommended Retail Price 5,000 yen (tax included)
Specification • Adopts six-axis sensing system
• Both wireless (Bluetooth®) and wired (USB) connection
• Lithium-ion battery

Product name Memory Card Adaptor
Product Code CECHZM1J
Release Date (in Japan) Saturday, November 11th, 2006





Recommended Retail Price 1,500 yen (tax included)
Specification • For importing games data saved on Memory Cards for PlayStation® and PlayStation®2 to the HDD in PLAYSTATION®3
• USB connection

Product name BD Remote Control
Product Code CECHZR1J
Release Date (in Japan) Thursday, December 7th, 2006
Recommended Retail Price 3,600 yen (tax included)
Specification • For easy operation of BD and DVD content
• Bluetooth® connection
Design and specifications are subject to change without notice.

About Sony Computer Entertainment Inc.

Recognized as the global leader and company responsible for the progression of consumer-based computer entertainment, Sony Computer Entertainment Inc. (SCEI) manufactures, distributes and markets the PlayStation® game console, the PlayStation®2 computer entertainment system, the PSP® (PlayStation®Portable) handheld entertainment system and the upcoming, much-anticipated PLAYSTATION®3 system. PlayStation has revolutionized home entertainment by introducing advanced 3D graphic processing, and PlayStation 2 further enhances the PlayStation legacy as the core of home networked entertainment. PSP is a new handheld entertainment system that allows users to enjoy 3D games, with high-quality full-motion video, and high-fidelity stereo audio. PLAYSTATION 3 is an advanced computer system, incorporating the state-of-the-art Cell processor with super computer like power. SCEI, along with its subsidiary divisions Sony Computer Entertainment America Inc., Sony Computer Entertainment Europe Ltd., and Sony Computer Entertainment Korea Inc. develops, publishes, markets and distributes software, and manages the third party licensing programs for these platforms in the respective markets worldwide. Headquartered in Tokyo, Japan, Sony Computer Entertainment Inc. is an independent business unit of the Sony Group.

